TM 9-1090-206-12

TECHNICAL MANUAL

AVIATION UNIT MAINTENANCE MANUAL FOR

ARMAMENT SUBSYSTEMS, HELICOPTER; 20-MM AUTOMATIC GUN: XM97E1 — PN 9324699 XM97E2 — PN 9324960

PREPARED BY
GENERAL ELECTRIC COMPANY

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HEADQUARTERS, DEPARTMENT OF THE ARMY

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WARNING

Personnel performing instructions involving operations, procedures, and practices which are included or implied in this technical manual shall observe the following instructions. Disregard of these warnings and precautionary information can cause serious injury or

DEATH

HIGH VOLTAGE

Personnel performing maintenance, adjustments, and/or troubleshooting in or around the turret system shall be aware that the system uses and generates LETHAL voltages which can cause injury or DEATH. Good practices, considering local conditions, shall be observed.

Care shall be exercised, when using metal tools, that circuits are not shorted. Some circuits have high current capability which when shorted will flash and may cause burns and/or eye injury.

Remove all jewelry and exposed metal objects from body and clothing before performing maintenance, adjustments, and/or troubleshooting to prevent personal injury.

CLEANING

Do not use cleaning solvents near an open flame. Fire extinguishers should be available when these materials are used. Use only in well-ventilated places.

Cleaning solvents evaporate quickly and have a drying effect on the skin. Gloves should be worn to avoid cracks in the skin, and in some cases mild irritation or inflammation of the skin.

Use and disposal of flammable and toxic materials will be in accordance with applicable regulations.

QUICK CHECK BORESIGHT

Before starting quick check boresight check procedures check that the gun and feed system are free of ammunition. No ammunition shall be left in the feed system or gun during boresight checks.

Prior to applying electrical power, clear turret area of any obstructions and warn personnel to stand clear. Erect a safety barrier around the area that gun barrels sweep.

Verify that power is removed from turret drive motor before performing following step.

LOADING/UNLOADING

A loaded turret system or a turret system being loaded or unloaded shall be pointed in a direction which offers the least exposure to personnel or property in the event of an accidental firing. Personnel shall remain clear of hazardous area of a loaded turret system.

Keep fingers and foreign material clear of feed chute.

SYSTEM TESTING AND TROUBLESHOOTING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

When performing troubleshooting, clear/safe M89E1 feeder, M197 gun, feed system and turret, observe all precautions governing care and handling of live ammunition.

POSTFLIGHT CHECK

Exercise care when performing postflight check. Gun barrels may be hot.

Keep fingers and foreign material clear of feed chute.

Do not walk in front of gun prior to verification of a safe weapon.

If disarming/safing is being performed with power on aircraft, do not enter 110^{o} left and right azimuth zone of barrel travel. Do not put hands up into turret system.

Observe all precautions governing care and handling of live ammunition.

JAMS

Clear gun and feeder. Follow a clearing procedure based on type of malfunction encountered. Observe all safety precautions.

OPERATION, CHECKOUT, AND MAINTENANCE

Operation of the turret system shall be performed only by authorized personnel. Verify that the turret system is unloaded and clear all obstruction from turret area before performing any operational check or precedure. All safety precautions and regulations shall be observed. Personnel shall remain clear of hazardous area bounded by safety area.

Make sure that aircraft power is off and that W2P1 to W3J1 is disconnected before performing any maintenance procedures.

Failure to perform a bore erosion test at scheduled intervals may result in ruptured barrels when the gun is fired and cause death or injury to personnel and damage to equipment.

Improper installation of barrels could allow barrel cluster to separate from gun and result in injury to personnel and damage to equipment.

Verify that M197 gun, M89E1 feeder, and feed system are clear of ammunition.

Observer shall remain outside of barrier zone when performing following step.

Exercise care when performing following steps. A fully loaded ammo box weighs approximately 500 pounds.

Keep fingers clear of gun rotor, breach bolts, and other moveable parts. Rear of gun must be supported at non-rotating, non-reciprocation areas to avoid injury to hands/fingers if barrel cluster is accidently rotated.

Exercise care when removing/installing firing pin in breech bolt. Firing pin may be propelled from bolt body with sufficient force to cause injury.

Exercise extreme care when hand feeding dummy rounds. Support rounds very lightly with finger tips and do not place fingers between rounds and rotor in direction of rotation.

Exercise care when working on feed chute. Sharp edges may cause injury.

Gun can be fired from the gunner cyclic stick with MASTER ARM switch set to OFF if PLT ORIDE switch is set to PLT ORIDE.

All repair work on polycarbonate (lexan) material will be performed in a hood-ventilated area.

To avoid injury to personnel or damage to Bore erosion gage, do not check a hot barrel. Incorrect readings will result if barrel is hot and the collet may seize the bore.

REFLEX SIGHT

Do not drop containers of compressed nitrogen gas. Under no circumstances exceed the pressures indicated below. Make certain the cylinder contains dry nitrogen.

AMMUNITION

Rechambering of live ammunition is prohibited. The use of previously chambered cartridges may result in damage to equipment or injury to personnel due to cartridge hangfire. Propellant-primer contamination, a cause of hangfire, can occur because the chambering action may loosen the projectile in the cartridge case and break the waterproof seal. Any cartridges that have been chambered and later extracted unfired will be disposed of in accordance with TM 9-1300-206 and/or local regulations.

TECHNICAL MANUAL
9-1090-206-12

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., 13 APRIL 1981

Aviation Unit Maintenance Manual

for

ARMAMENT SUBSYSTEMS, HELICOPTER; 20-MM AUTOMATIC GUN: XM97E1 (PN 9324699) XM97E2 (PN 9324960)

REPORTING OF ERRORS

You can help improve this manual by calling attention to errors and by recommending improvements and stating your reasons for the recommendations. Your letter or DA Form 2028, Recommended Changes to Publications, should be mailed directly to Commander, US Army Armament Material Readiness Command, Attn: DRSAR-MAS, Rock Island, IL. 61299. A reply will be furnished directly to you.

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CHAPTER 1
INTRODUCTION

Section I. GENERAL

1-1. Scope. This manual is for your use in performing aviation unit maintenance of the 20-mm Automatic Gun Helicopter Armament Subsystems XM97E1 and XM97E2 when installed in the Army Model AH-1S Helicopter. The 20-mm Automatic Gun Helicopter Armament Subsystems XM97E1 and XM97E2 are commonly referred to individually as a Universal Turret System (UTS).

1-2. Maintenance Forms and Records. Maintenance forms and records which are to be used by maintenance personnel at all maintenance levels are listed in and prescribed by TM 38-750.

1-3. Administrative Storage. Refer to TM 740-90-1 for instructions pertaining to administrative storage.

1-4. Destruction of Army Materiel to Prevent Enemy Use. Refer to TM 750-244-1-5 for instructions pertaining to destruction of army materiel to prevent enemy use.

1-5. Quality Assurance/Quality Control (QA/QC). Information not available.

1-6. Reporting Equipment Improvement Recommendations (EIR). EIRs will be prepared on Standard Form 368, Quality Deficiency Record. Instructions for preparing EIRs are provided in TM 38-750, The Army Maintenance Management System. EIRs should be mailed directly to Commander, U.S. Army Armament Materiel Readiness Command, ATTN: DRSAR-MAO, Rock Island, Il. 61299. A reply will be furnished directly to you.

1-6.1 Designator Symbols. Designator symbols such as E (UTS XM97E1) and M (UTS XM97E2) are used in conjunction with text headings, text contents, table titles, and illustration titles to show effectivity of the material. One or more symbols may follow a text heading, precede an illustration or table title, or precede a procedural step, to indicate effectivity; unless the material is applicable to all series and configurations. If the material is applicable to all series and configurations, no symbols will be used. Where practical, descriptive information is condensed and combined for all models to avoid duplication.

Section II. DESCRIPTION AND TABULATED DATA

1-7. Description.

a. *Universal Turret System* (fig. 1-1). The Universal Turret System (UTS) is chin-mounted on the AH-1S aircraft and provides high performance armament. The major components of the turret system are the Declutching Feeder M89E1, 20-mm Automatic Gun M197, Helicopter Armament Subsystem Turret, Gunner Control Panel, Pilot Control Panel, Interface Control Unit, Reflex Sight E, Pressure Transducer, turret buffer amplifier M, logic relay assembly M, and acquisition switch panel. Refer to figure 1-1 for identification and location of the major components of the UTS.

(1) *Declutching Feeder M89E1* (fig. 1-2). The Declutching Feeder M89E1 (M89E1 feeder) is mounted on and geared to the 20-mm Automatic Gun M197. A solenoid-operated declutching mechanism controls the operation of the feeder. The link eject chute directs the empty links ejected from the feeder clear of the aircraft. The rounds sensing switch provides electrical counting pulses to the RD RMNG indicator on the gunner control panel and to the rounds totalizer on the turret.

(2) *20-mm Automatic Gun M197* (fig. 1-3). The 20-mm Automatic Gun M197 (M197 gun) is an air-cooled, three-barrel weapon. The M197 gun utilizes a rotary action mechanism contained within a fixed housing and a rotating barrel cluster. The components of the M197 gun are the mid-barrel clamp, three breech bolt assemblies, firing contact assembly, matched housing, and rotor assembly. The maintenance paragraphs of this manual contain descriptions of the M197 gun components.

(3) *Helicopter Armament Subsystem Turret.* The Helicopter Armament Subsystem Turret (turret subsystem) includes the gun drive assembly, recoil attenuation system, turret assembly, ammunition feed system, gun control assembly, turret control assembly and logic control assembly (fig. 1-1). The maintenance paragraphs of this manual contain descriptions of the turret subsystem components.

(a) *Gun Drive Assembly* (fig. 1-4). The gun drive assembly (gun drive) consists essentially of a gearbox and a dc motor. The gearbox

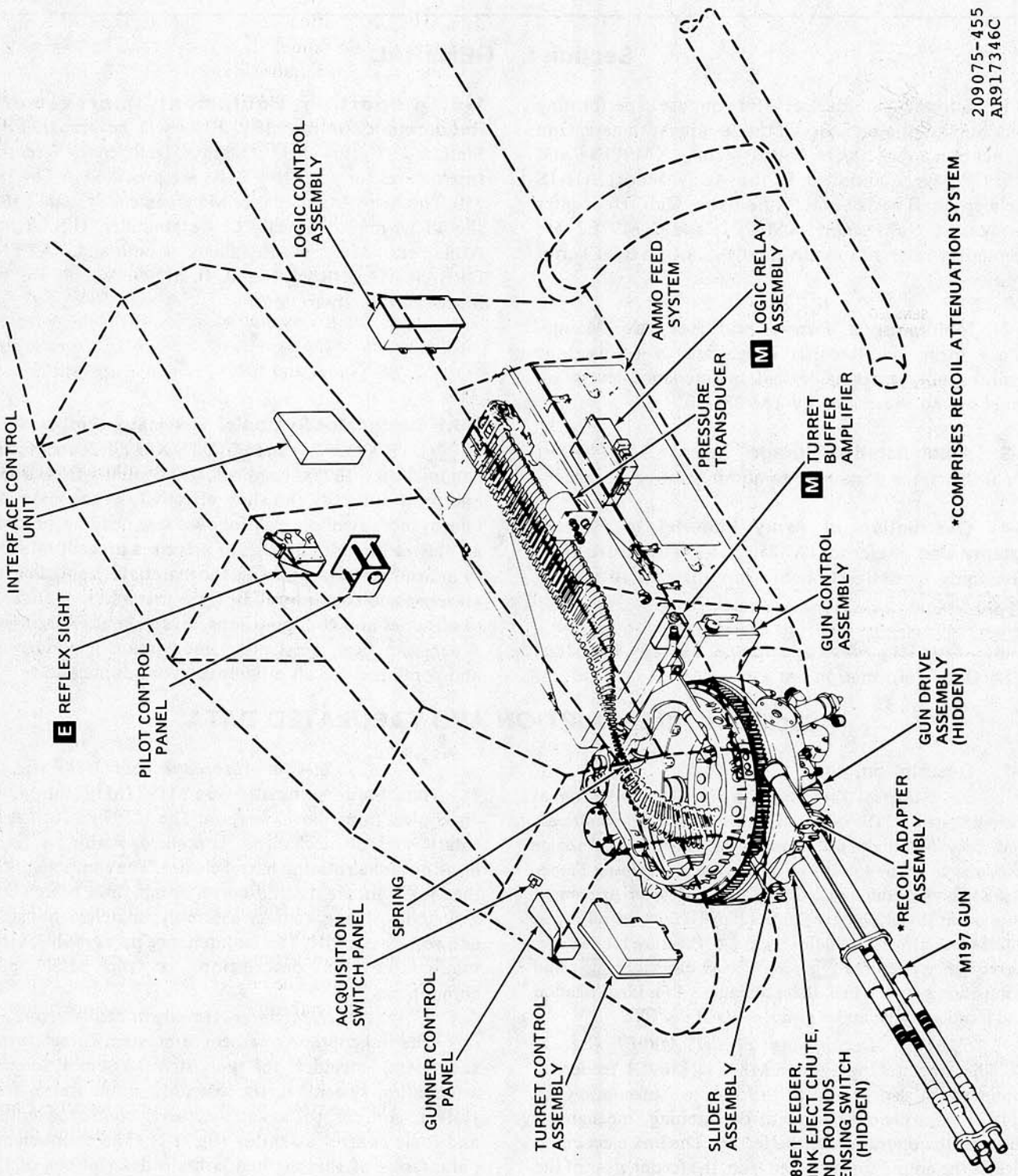


Figure 1-1. Universal Turret System (Typical)

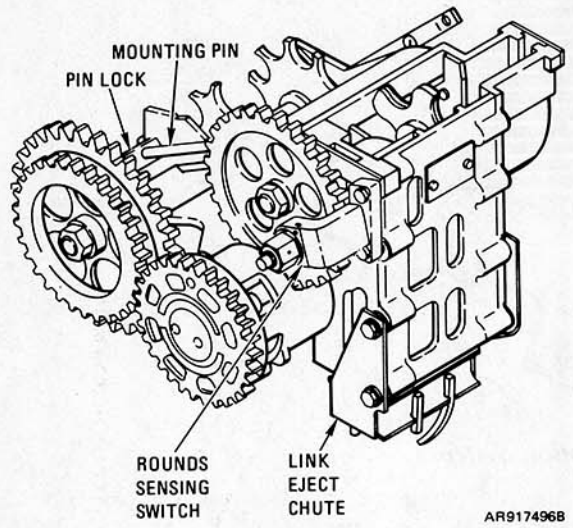


Figure 1-2. Declutching Feeder M89E1

encloses a gear train with an output gear that is exposed when not secured to the M197 gun.

(b) *Recoil Attenuation System* (fig. 1-5). The recoil attenuation system consists of a recoil adapter and a slider assembly. This combination provides forward mounting for the M197 gun.

(c) *Turret Assembly* (fig. 1-6). The turret assembly (turret) consists of the upper support assembly, lower support assembly, and the saddle assembly.

(d) *Ammunition Feed System* (fig. 1-7). The ammunition feed system consists of an ammunition box, cover assembly, bellmouth guide, booster assembly, and a flexible feed chute.

(e) *Gun Control Assembly* (fig. 1-8.). The gun control assembly (gun control), mounted on a bulkhead aft of the turret, controls voltages for the gun drive power, firing, and feeder solenoid operation.

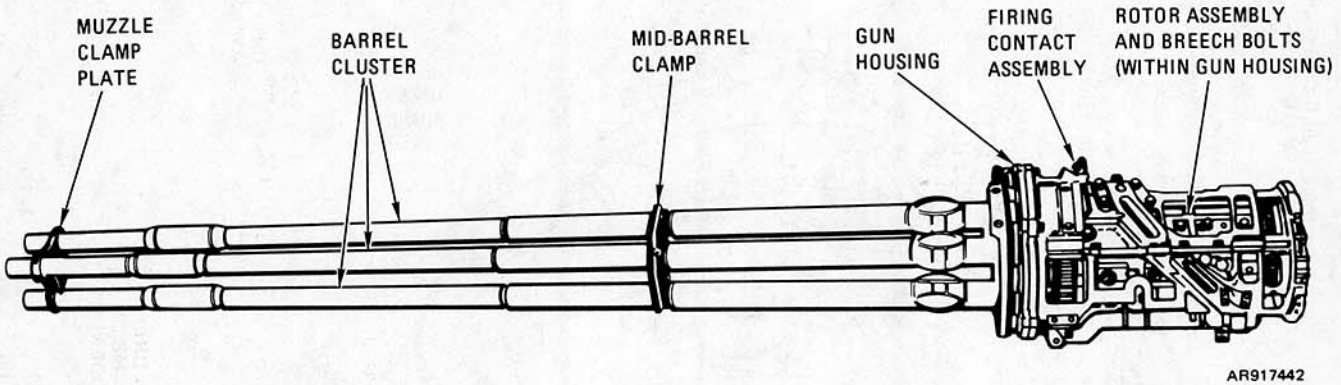


Figure 1-3. 20-mm Automatic Gun M197

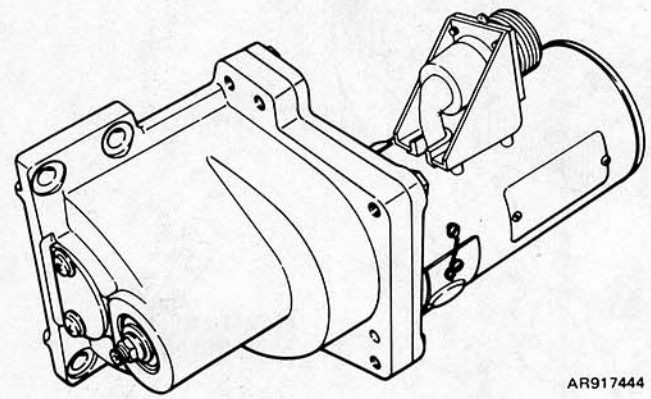


Figure 1-4. Gun Drive Assembly

(f) *Turret Control Assembly* (fig. 1-9). The turret control assembly (turret control), below the gunner control panel, controls power to turret motors for azimuth and elevation positioning.

(g) *Logic Control Assembly* (fig.1-10). The logic control assembly (logic control) is mounted on the left side of the aircraft aft of the ammunition compartment. It contains a time totalizer, printed circuit boards and provides stabilization control.

(4) *Gunner Control Panel* (fig. 1-11). The gunner control panel is mounted in the right console at the gunner station. The control panel contains switches and indicators to enable gunner control and operation of the turret system.

(5) *Pilot Control Panel* (fig. 1-12). The pilot control panel is mounted in the console at the pilot station. The control panel contains switches and indicators to enable pilot control and operation of the turret system.

(6) *Interface Control Unit* (fig. 1-13). The interface control unit (IFCU) is located in the right access compartment below the wing. The IFCU contains signal switching, buffering and alignment, range compensation, airspeed compensation, and depression limit circuitry.

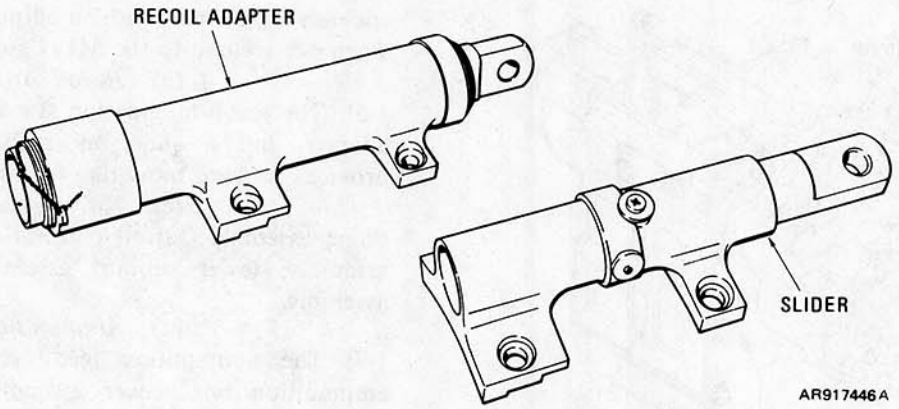


Figure 1-5. Recoil Attenuation System

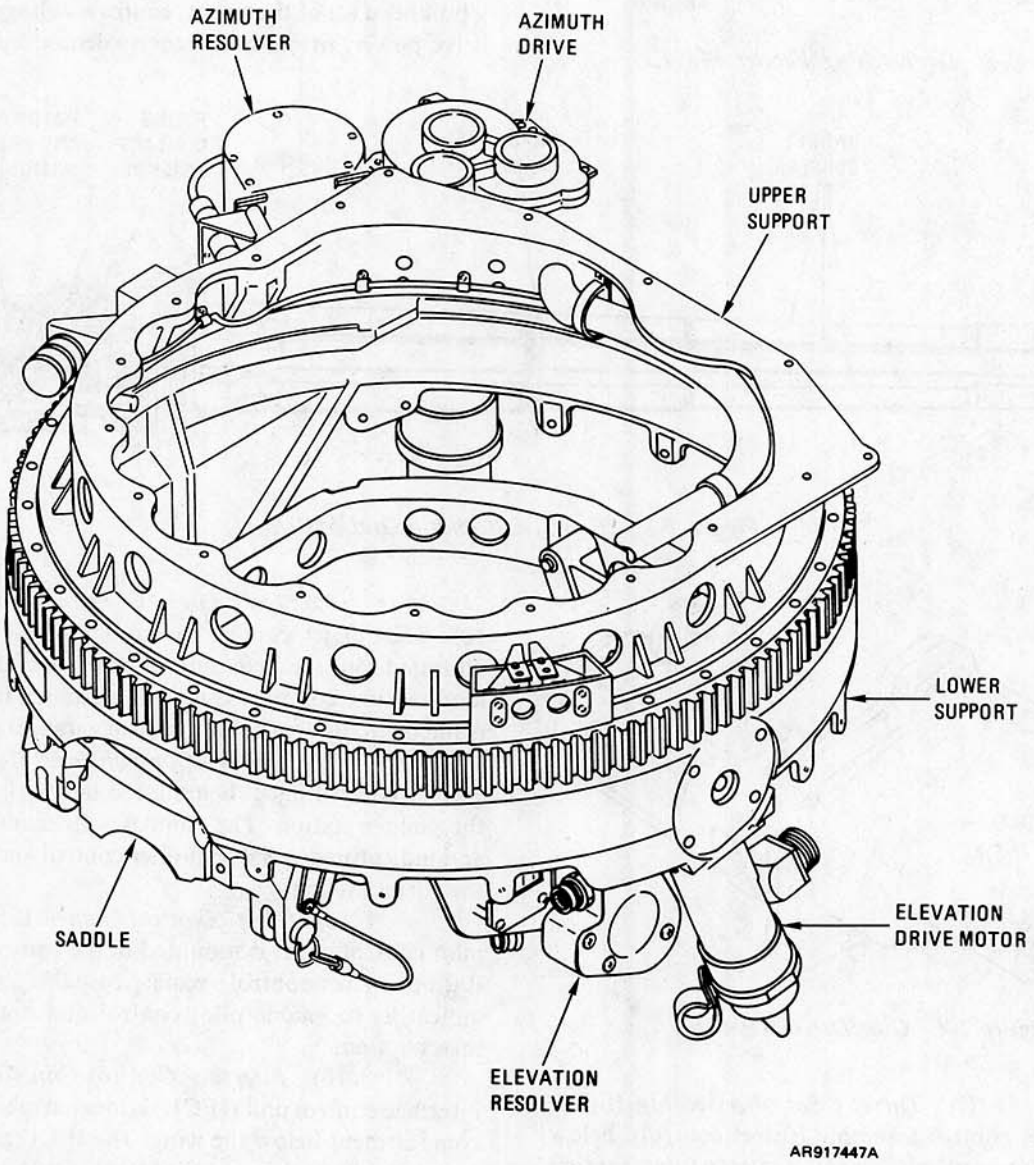


Figure 1-6. Turret Assembly

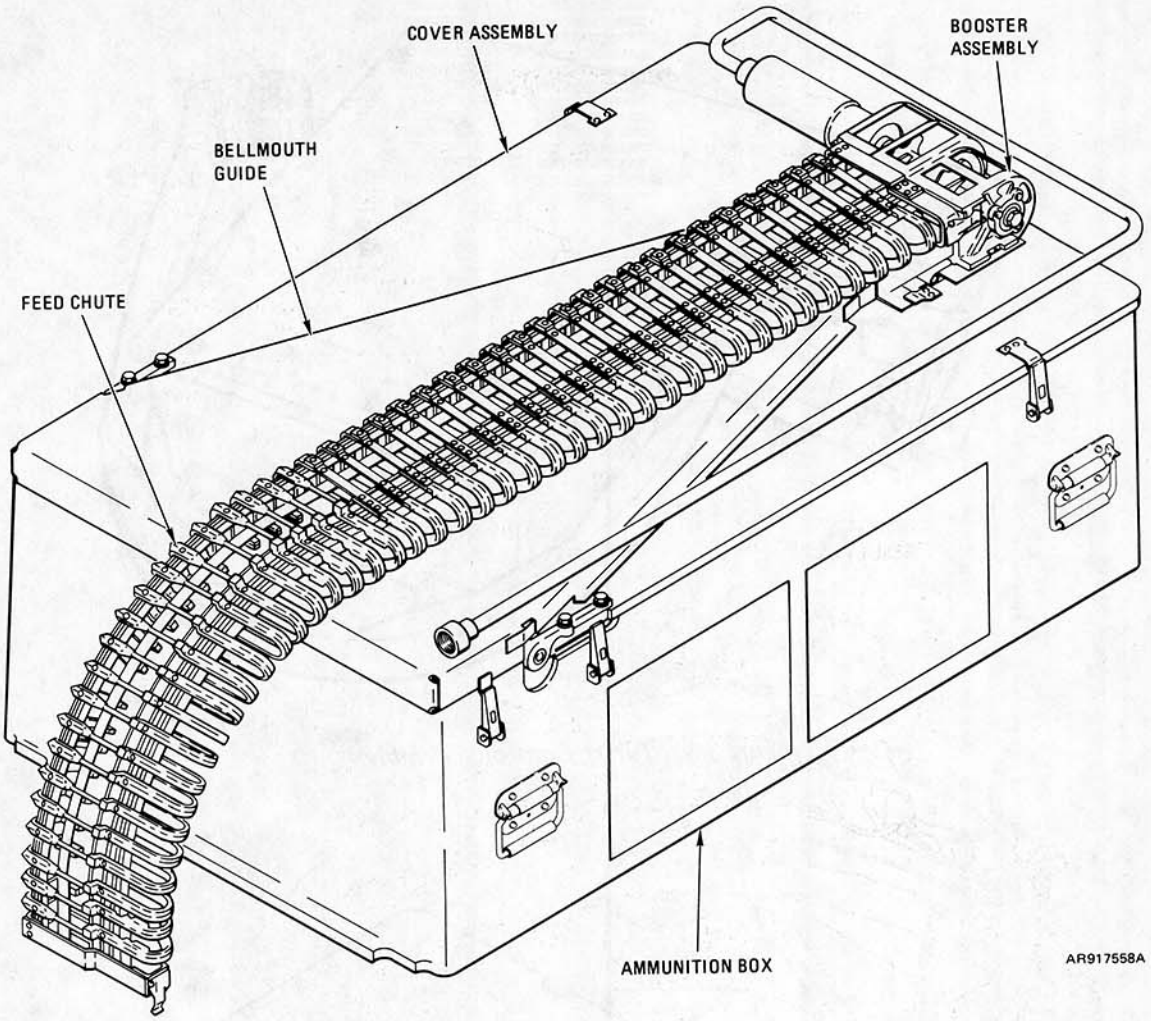


Figure 1-7. Ammunition Feed System

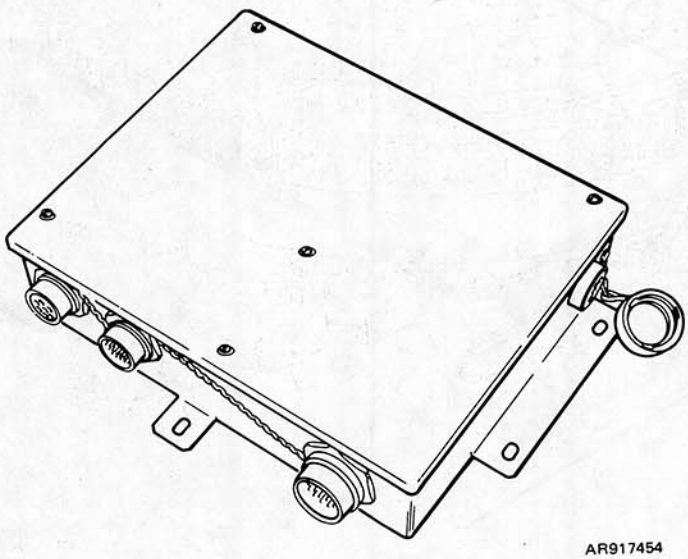


Figure 1-8. Gun Control Assembly

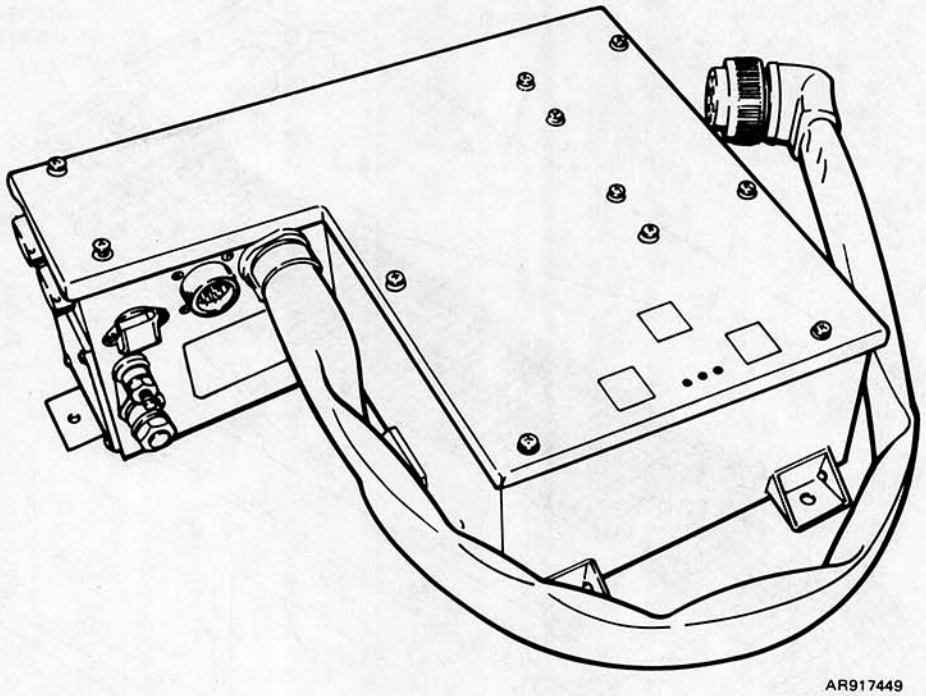


Figure 1-9. Turret Control Assembly

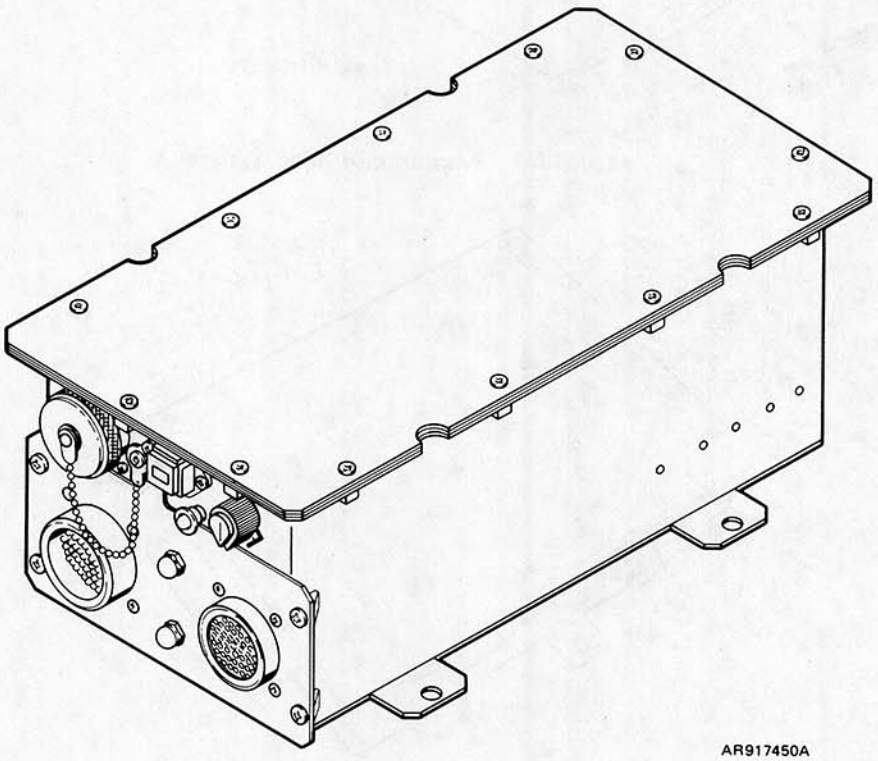


Figure 1-10. Logic Control Assembly

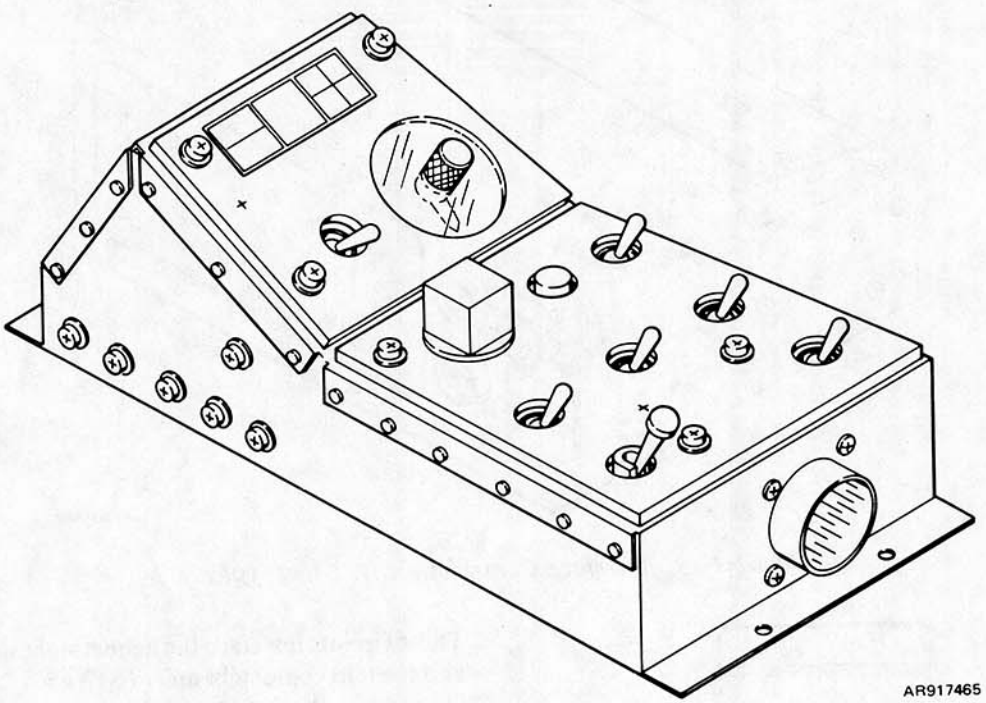


Figure 1-11. Gunner Control Panel (Typical)

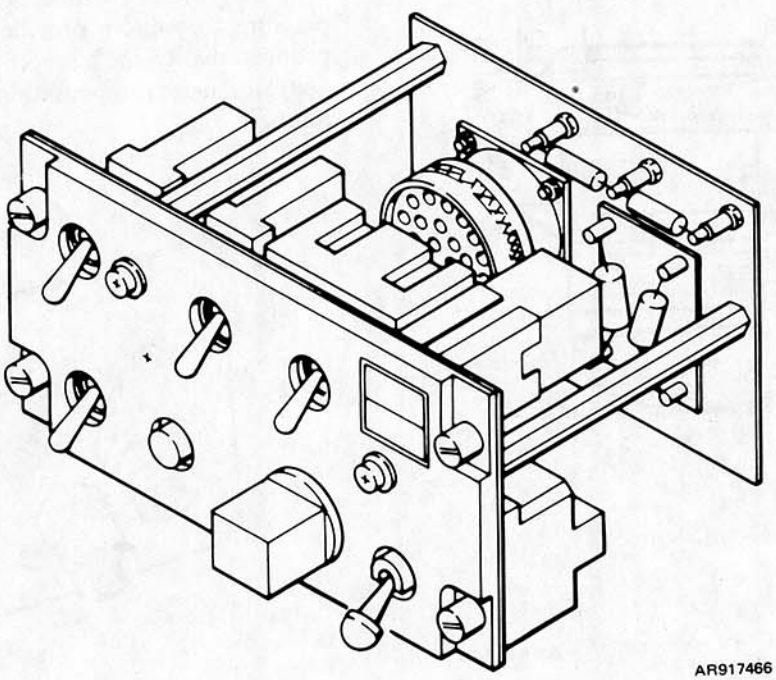


Figure 1-12. Pilot Control Panel (Typical)

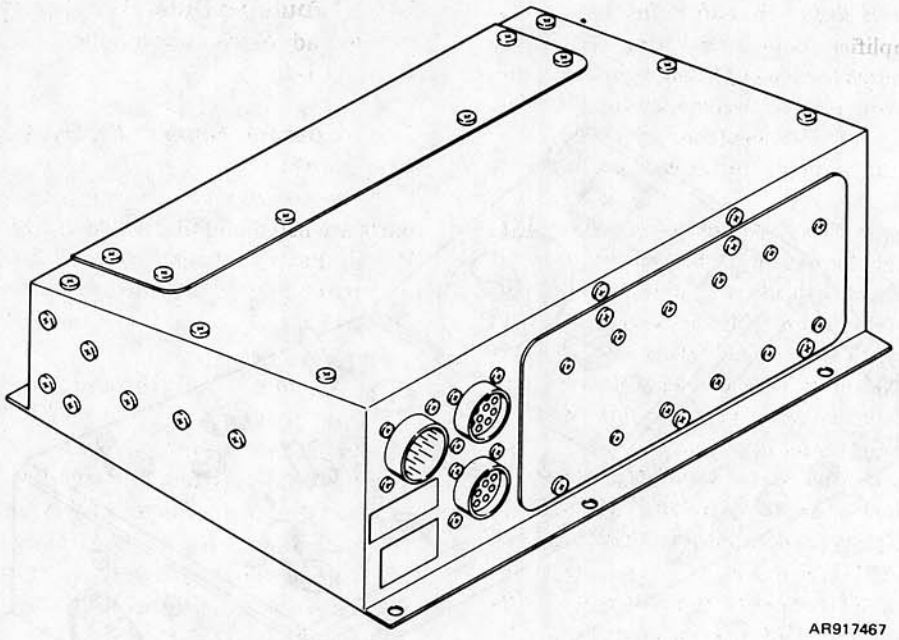
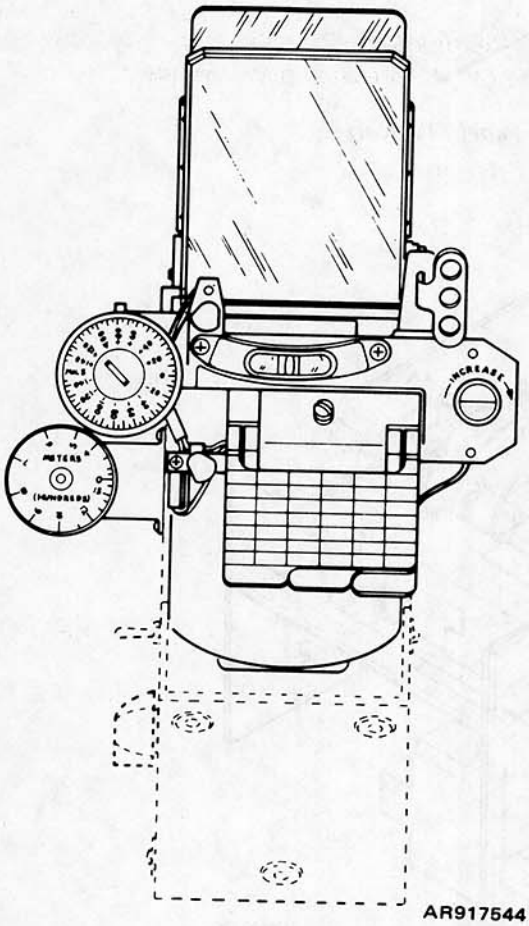


Figure 1-13. Interface Control Unit (IFCU) (Typical)



E *Figure 1-14. Reflex Sight*

These circuits interface the helmet sight subsystem (HSS) and the telescopic sight unit (TSU) with the turret system.

(7) *Reflex Sight* (fig. 1-14) E. The reflex sight is located above the pilot instrument panel. It provides an illuminated, projected reticle image for pilot use when firing the wing stores or turret from a target collision course.

(8) *Pressure Transducer* (fig. 1-15). The pressure transducer provides an output signal that is proportional to the airspeed of the aircraft. This signal activates turret compensation circuits to prevent velocity jump.

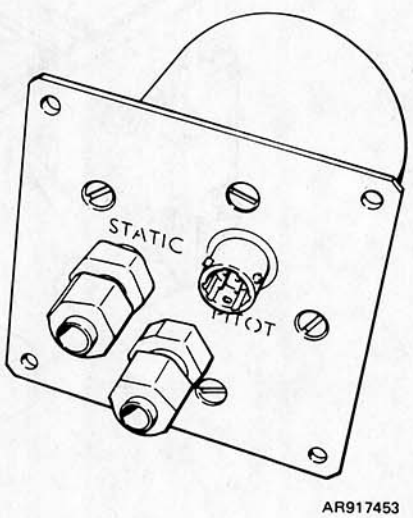


Figure 1-15. Pressure Transducer

(9) *Turret Buffer Amplifier* (fig. 1-15.1) M. The turret buffer amplifier contains buffering circuitry to eliminate noise and provides loads for the turret resolvers which are compatible with resolver design requirements. This unit also contains relay interlock switching which will cause interruption of the firing voltage if an internal power supply failure occurs.

(10) *Logic Relay Assembly* (fig. 1-15.2) M. The logic relay assembly located on the bottom surface of the ammunition compartment floor (fig. 1-1), provides a compact installation for most of the control relays peculiar to the AH-1S (MC). The primary function of the logic relay assembly is to provide switching for the turret, TOW, and wing stores system. Additional functions include night vision goggle switching and armament system indicator light control.

(11) Acquisition Switch Panel (fig. 1-15.3). The acquisition switch panel is used to control the TSU for target acquisition. With ACQ switch positioned to NORM M, (or not pressed E), the TSU is controlled by using track control stick when ACQ/TRK/STOW switch is positioned to TRK. With ACQ switch position to PHS M, (or pressed E), the TSU is slaved to pilot helmet sight. With ACQ switch positioned to ALT M, the TSU is slaved to the airborne laser tracker.

1-8. Controls and Indicators. The controls and indicators for the components of the turret system are identified in figures 1-16, 1-16.1 and listed in table 1-1.

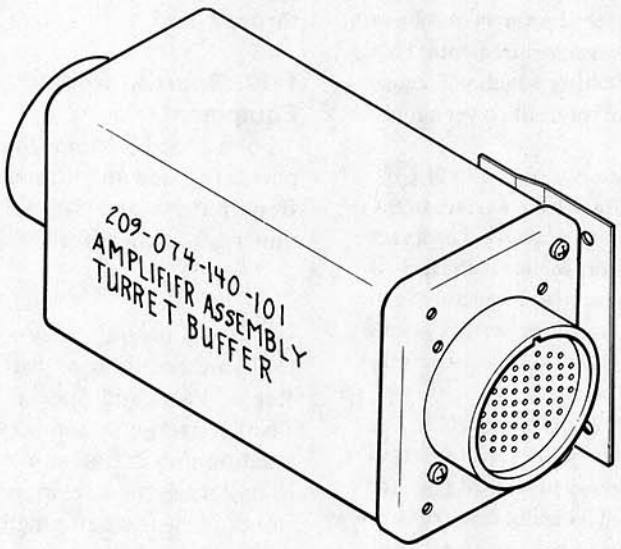
1-9. Tabulated Data. The characteristics of the turret system and its major components are listed in tables 1-2 through 1-15.

1-10. Spares, Repair Parts, Special Tools and Equipment.

a. *Spares and Repair Parts.* Spares and repair parts are listed and illustrated in TM 9-1090-206-20P, the Repair Parts and Special Tools List, covering aviation unit maintenance for this equipment.

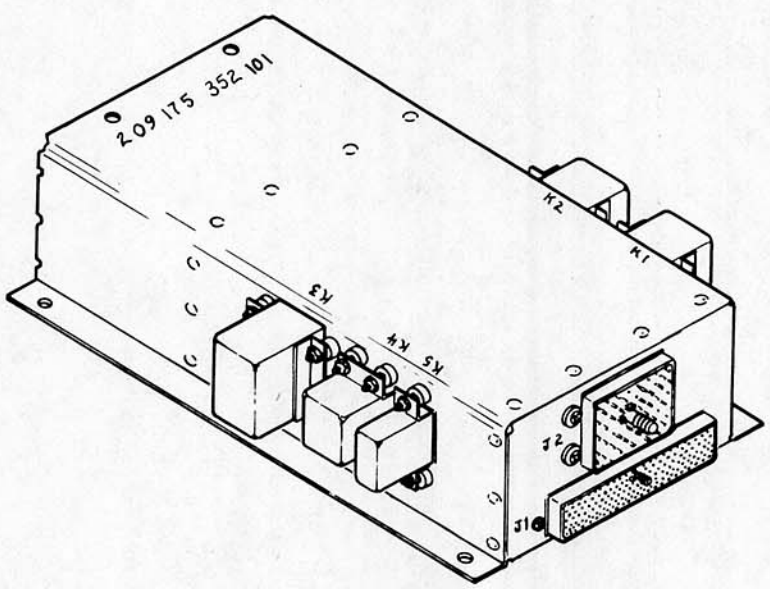
b. *Special Tools and Equipment.* No special tools are required or listed in TM 9-1090-206-20P, the Repair Parts and Special Tools List for this equipment. The Electronic System Test Set XM137 is authorized for aviation unit maintenance of this equipment. The test set is designed for use in performing checkout and fault isolation of the equipment. A complete description and maintenance instructions for the test set are contained in TM 9-4933-224-13&P.

1-11. Identification Plates. The locations of the equipment identification plates are identified in table 1-16.



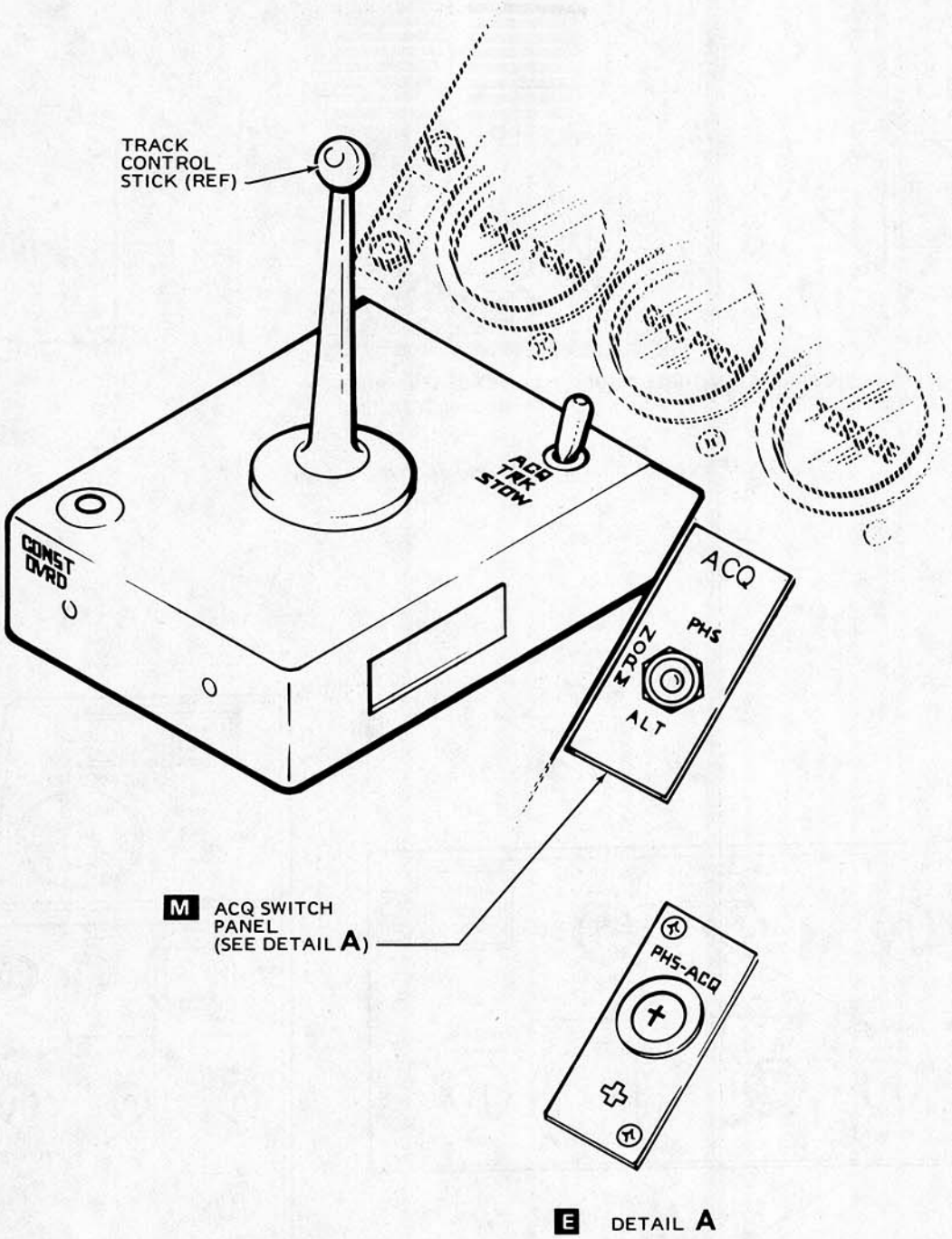
209074-66
ARR80-0002

M *Figure 1-15.1.. Turret Buffer Amplifier*



209175-3
ARR80-0003

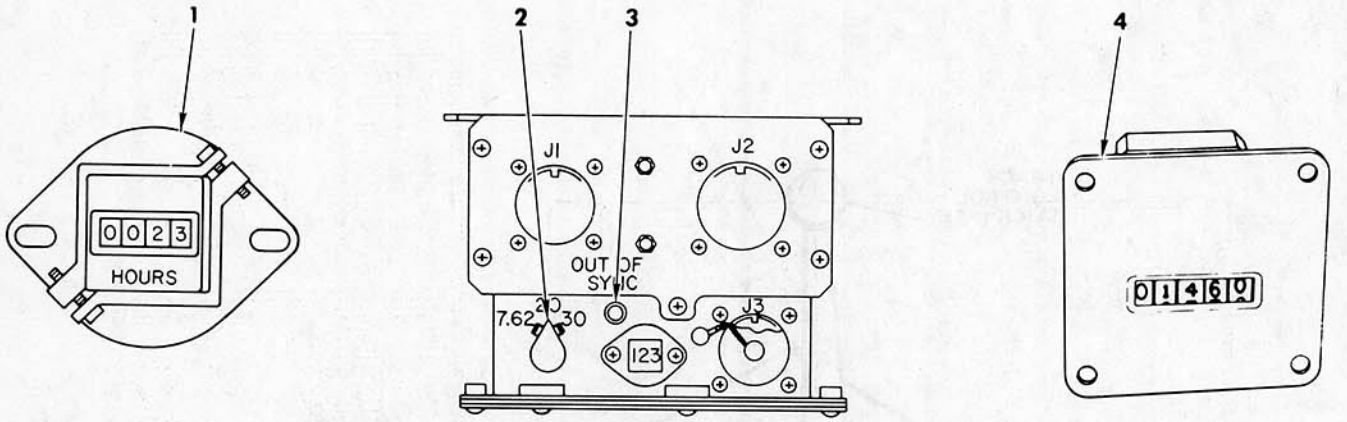
M *Figure 1-15.2. Logic Relay Assembly*



209075-458

Figure 1-15.3 Acquisition Switch Panel

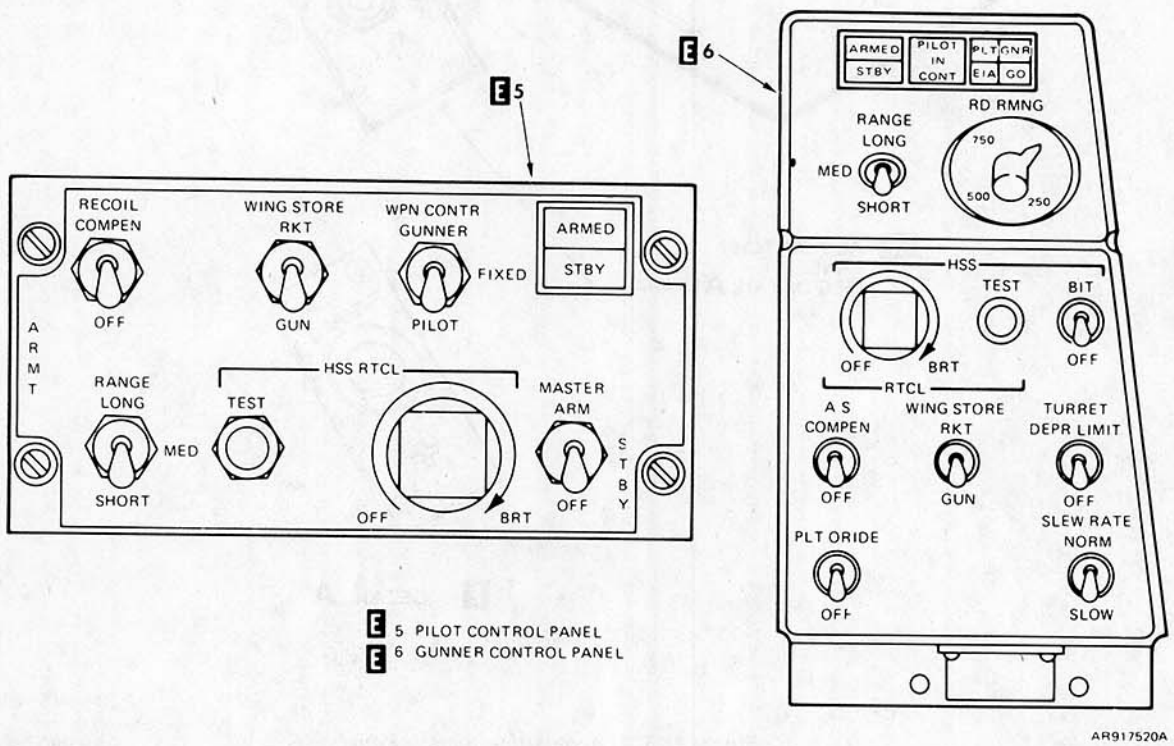
ARR80-0004



1 ELAPSED TIME INDICATOR (THREE USED)
2 GUN SELECT SWITCH
3 OUT OF SYNC INDICATOR
4 ROUNDS TOTALIZER

AR917345A

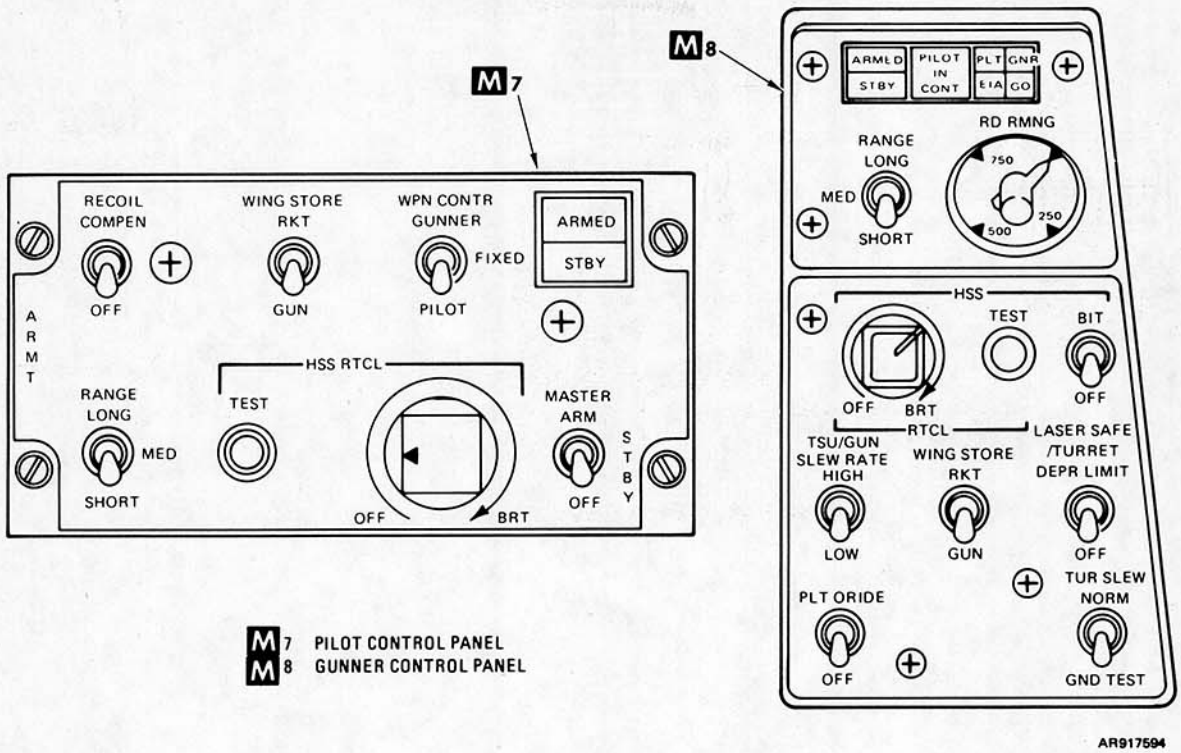
Figure 1-16. Controls and Indicators (Sheet 1 of 3)



E 5 PILOT CONTROL PANEL
E 6 GUNNER CONTROL PANEL

AR917520A

E *Figure 1-16. Controls and Indicators (Sheet 2 of 3)*



M *Figure 1-16. Controls and Indicators (Sheet 3 of 3)*

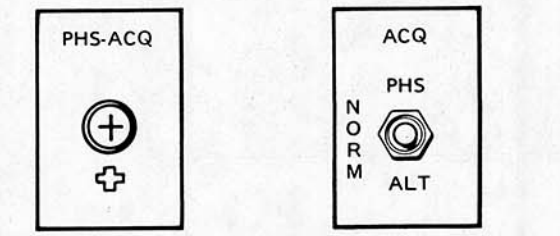


Figure 1-16.1 Controls and Indicators

Table 1-1. Controls and Indicators

Fig. 1-16, 1-16.1 & Index No.	Control		Function
1	Elapsed time indicator (three used)		Indicates total time power (115 Vac) is applied to gun control, turret control and logic control.
2	Gun select switch	20	Compensates for 20-mm turret weapon recoil force on aircraft stability and control augmentation system (SCAS).
3	Out of sync indicator		Indicates resolver system misalignment greater than 90°.
4	Rounds totalizer		Indicates number of rounds that pass through feeder.
E 5	Pilot control panel	RECOIL OFF	Deactivates turret system gun recoil compensation circuits from aircraft SCAS.
		RECOIL COMPEN	Activates turret system gun recoil compensation circuits in SCAS.
		WING STORE GUN	Permits pilot to activate external gun pod system.
		WING STORE RKT	Permits pilot to activate external rockets.
		WPN CONTR PILOT	Permits pilot to fire turret using helmet sight subsystem (HSS) and wing stores (except TOW) using reflex sight.
		WPN CONTR FIXED	Permits pilot to fire turret and wing stores (except TOW) using reflex sight.
		WPN CONTR GUNNER	Permits gunner to fire turret using HSS or telescopic sight unit (TSU) and TOW using TSU.
		ARMED	Indicates pilot MASTER ARM switch in ARM.
		STBY	Indicates pilot MASTER ARM switch in STBY.
		WARNING	
		Pilot MASTER ARM switch bypassed when gunner control panel PLT ORIDE switch is in PLT ORIDE. Gun can be fired by gunner.	
		MASTER ARM OFF	Deactivates all sights and weapon control/firing circuits.

Table 1-1. Controls and Indicators — Continued

Fig. 1-16, 1-16.1 & Index No.	Control	Function	
E 5	Pilot control panel - cont.	MASTER ARM STBY	Activates all sights, turret, and TOW control circuits.
		MASTER ARM	Activates all sights and weapon control/firing circuits. Charges wing gun pod weapon system battery.
		HSS RTCL OFF/BRT	Deactivates pilot HSS reticle lights. When rotated, varies intensity of pilot HSS reticle lights.
		HSS RTCL TEST	Tests pilot HSS reticle.
		RANGE SHORT/MED/ LONG	Provides target range data to turret elevation compensation circuitry.
E 6	Gunner control panel	ARMED	Indicates pilot MASTER ARM switch in ARM.
		STBY	Indicates pilot MASTER ARM switch in STBY.
		PILOT IN CONT	Indicates pilot WPN CONTR switch in PILOT, and pilot has control of armament system.
		PLT	Indicates failure in pilot HSS.
		EIA	Indicates failure in electronic interface assembly of HSS.
		GNR	Indicates failure of gunner HSS.
		GO	Indicates pilot and gunner HSS operating properly.
		RD RMNG	Indicates number of rounds remaining in turret ammunition feed system.
		HSS BIT OFF	Deactivates pilot and gunner HSS built-in test circuit.
		HSS BIT	Tests pilot and gunner HSS when linkage arms are attached to BIT magnets.
		HSS RTCL TEST	Tests gunner HSS reticle.
		HSS RTCL OFF/BRT	Deactivates gunner HSS reticle lights. When rotated, varies intensity of gunner HSS reticle lights.
		TURRET DEPR LIMIT OFF	Permits turret travel to maximum down elevation.
		TURRET DEPR LIMIT	Limits downward travel to prevent turret system gun from striking ground.
		SLEW RATE SLOW	Limits turret slew rate during turret maintenance.
		SLEW RATE NORM	Allows turret to slew at operating rate.
		PLT ORIDE OFF	Permits pilot to control armament system.
		PLT ORIDE	Overrides pilot control panel. Permits gunner to fire turret weapons using HSS, and wing stores (except TOW) without sight.

Table 1-1. Controls and Indicators — Continued

Fig. 1-16, 1-16.1 & Index No.	Control	Function	
E 6	Gunner control panel - cont.	WING STORE GUN	Permits gunner to activate wing gun pod.
		WING STORE RKT	Permits gunner to activate external rockets.
		A/S COMPEN OFF	Deactivates turret positioning circuits.
		A/S COMPEN	Applies airspeed/range data to turret positioning circuits.
		RANGE SHORT/ MED/LONG	Provides target range data to turret elevation compensation circuitry.
M 7	Pilot control panel	RECOIL OFF	Deactivates turret system gun recoil compensation circuits from aircraft SCAS.
		RECOIL COMPEN	Activates turret system gun recoil compensation circuits to aircraft SCAS.
		WING STORE GUN	Permits pilot or gunner to fire wing mounted gun.
		WING STORE RKT	Permits pilot or gunner to fire rockets.
		WPN CONTR PILOT	Permits pilot to fire turret using HSS and wing stores (except TOW) using HUD.
		WPN CONTR FIXED	Permits pilot to fire turret and wing stores (except TOW) using HUD.
		WPN CONTR GUNNER	Permits gunner to fire turret using HSS or TSU and TOW using TSU.
		ARMED	Indicates MASTER ARM switch in ARM.
		STBY	Indicates MASTER ARM switch in STBY.
		Off	Indicates MASTER ARM switch in OFF.
		Press	Tests indicator lights.
		WARNING MASTER ARM switch is bypassed when gunner control panel PLT ORIDE switch is in PLT ORIDE.	
		MASTER ARM OFF	Deactivates all sights and weapon control/ firing circuits.

Table 1-1. Controls and Indicators — Continued

Fig. 1-16, 1-16.1 & Index No.	Control	Function	
M 7	Pilot control panel - cont.	MASTER ARM STBY	Activates all sights, turret, and TOW control circuits. Charges wing gun pod battery.
		MASTER ARM	Activates all sights and weapon control/firing circuits. Charges wing gun pod battery.
		HSS RTCL OFF/BRT	Deactivates pilot HSS reticle lights. When rotated, varies intensity of pilot HSS reticle lights.
		HSS RTCL TEST	Tests pilot HSS reticle.
		RANGE SHORT/ MED/LONG	Provides target range data to turret elevation compensation circuitry.
M 8	Gunner control panel	ARMED	Indicates pilot MASTER ARM switch in ARM.
		STBY	Indicates pilot MASTER ARM switch in STBY.
		Off	Indicates pilot MASTER ARM switch in OFF.
		Press	Tests indicator lights.
		PILOT IN CONT	Indicates pilot has control of turret.
		Off	Indicates gunner has control of turret or pilot MASTER ARM switch in OFF.
		Press	Tests indicator light.
		PLT	Indicates failure in pilot HSS.
		EIA	Indicates failure in electronics interface assembly.
		GNR	Indicates failure in gunner HSS.
		GO	Indicates pilot and gunner HSS operating properly.
		Press	Tests indicator lights.
		Off	Indicates HSS built-in test not being conducted.
		RD RMNG	Indicates number of rounds remaining for turret weapon.
		HSS BIT OFF	Deactivates pilot and gunner HSS built-in test.
		HSS BIT	Tests pilot and gunner HSS when linkage arms are attached to BIT magnets.
		HSS RTCL TEST	Tests gunner HSS reticle.

Table 1-1. Controls and Indicators — Continued

Fig. 1-16, 1-16.1 & Index No.	Control	Function	
M 8	Gunner control panel - cont.	HSS RTCL OFF/BRT	Deactivates gunner HSS reticle lights. When rotated, varies intensity of gunner HSS reticle lights.
		LASER SAFE/ TURRET DEPR LIMIT OFF	Permits turret to travel to maximum down elevation.
		LASER SAFE/ TURRET DEPR LIMIT	Limits downward travel to prevent turret weapon from striking ground and prevents laser from firing.
		TUR SLEW GND TEST	Used for ground operations servicing only. Limit turret slew rate in azimuth and elevation to 4 to 8 degrees per second.
		TUR SLEW NORM	Allows turret to slew in azimuth and elevation at 60 degrees per second.
		PILOT ORIDE OFF	Permits pilot control panel to control weapons.
		PLT ORIDE	Overrides pilot control panel. Permits gunner to fire turret using HSS, and wing stores (except TOW) without sight.
		WING STORE GUN	Permits gunner to fire wing mounted gun.
		WING STORE RKT	Permits gunner to fire rockets.
		TSU/GUN SLEW RATE LOW	Selects low slew rate for TSU when TOW control panel mode select switch is in TSU/GUN position.
		TSU/GUN SLEW RATE HIGH	Selects high slew rate for TSU when TOW control panel mode select switch is in TSU/GUN position.
		RANGE SHORT/ MED/LONG	Provides target range data to turret elevation compensation circuitry.
E 9	Acquisition switch panel	Pressed (PHS) Released (normal)	Slaves TSU to PHS. Track control stick controls TSU.
M 10	Acquisition switch panel	PHS NORM ALT	Slaves TSU to PHS. Track control stick controls TSU. Slaves TSU to ALT.

Table 1-2. Turret System Characteristics

Mounting:	Chin
Ammunition:	20 mm (M50 series), belted (M14A2 links)
Capacity:	750 rounds
Firing rate:	730 ±50 shots-per-minute (spm)
Power requirements:	28 Vdc 115 Vac, 400 Hz
System weight:	
Loaded:	Approx 1000 lbs.
Without gun, feeder and ammunition:	416 lbs.
Reload turnaround time:	10 minutes

Table 1-3. M89E1 Feeder Characteristics

Length:	13 in.
Height:	8 in.
Width:	9.5 in.
Weight:	22.5 lbs.
Type of link:	M14 series and RADHAZ
Type of ammunition:	M50 series
Power:	Gun driven
Solenoid power:	28 Vdc

Table 1-4. M197 Gun Characteristics

Gun:	
Rotation	Counterclockwise viewed from breech end
Drive	External
Caliber	20 mm
Length overall	72 in.
Weight	139 lbs.
Firing voltage	250-400 Vdc, 0.5 amps
Barrels:	
Number of barrels	3
Length	60 in.
Number of lands	9
Twist	Right-hand gain twist
Rate of fire:	730 ±50 shots-per-minute (spm)

Table 1-5. Gun Drive Characteristics

Drive motor:	
Voltage	28 Vdc
Speed	6500 rpm
Direction of rotation:	Clockwise when viewed from spline end
Weight:	11.4 lbs.

Table 1-6. Recoil Attenuation System Characteristics

	Recoil Adapter	Slider
Weight	7.9 lbs.	4.2 lbs.
Service life	60,000 rounds	60,000 rounds
Preload	200 ±50 lbs.	Not applicable
Recoil movement	1.5 inches max.	Not applicable

Table 1-7. Ammunition Feed System Characteristics

Ammunition box:	
Capacity	750 rounds of linked 20-mm ammunition
Weight:	
Empty	93 lbs.
Loaded	520 lbs.
Dimensions:	
Height	18 in.
Width	26.5 in.
Length	44 in.
Booster assembly:	
Weight	8.5 lbs.
Booster	
Power	
Voltage	+22.5 to 30 Vdc
Feed chute:	
Weight	16 lbs.
Dimensions:	
Height	3.5 in.
Width	7.5 in.
Length (extended)	90 in.

Table 1-8. Gun Control Characteristics

Power requirements:	+28(+2, -6) Vdc. 15 amps max. 115 ±5 Vac, 400 ±20 Hz. 95 VA max.
Weight:	8.4 lbs.
Dimensions:	
Height	2.78 in.
Width	8.95 in.
Length	12.09 in.

Table 1-9. Turret Control Characteristics

Power requirements:	Low level dc: +28, +2, -6 Vdc, 2 amp max. High level dc: +28, +2, -6 Vdc, 200 amp max. AC: 115 ±5 Vac, 400 ±20 Hz, 95 volt-amp max. 26 ±5 Vac, 400 ±20 Hz
Weight:	15.6 lbs.
Dimensions:	
Height	5.16 in.
Width	10.16 in.
Length	12.72 in.

Table 1-10. Logic Control Characteristics

Power requirements:	+18 Vdc −18 Vdc 28 Vdc 26 Vac 115 Vac
Weight:	4.8 lbs.
Dimensions:	
Height	4.3 in.
Width	5.4 in.
Length	11.3 in

Table 1-11. Gunner Control Panel Characteristics (Typical)

Weight:	2.5 lbs.
Dimensions:	
Height	3.8 in.
Width	4.8 in.
Length	10.9 in.

Table 1-12. Pilot Control Panel Characteristics (Typical)

Weight:	1.5 lbs.
Dimensions:	
Height	3.0 in.
Width	4.4 in.
Length	5.8 in.

E *Table 1-13. Interface Control Unit Characteristics*

Power requirements:	28 Vdc 115 Vac
Weight:	14.0 lbs.
Dimensions:	
Height	5.3 in.
Width	11.5 in.
Length	15.0 in.

M *Table 1-13.1 Interface Control Unit Characteristics*

Power requirements:	28 Vdc 115 Vac
Weight:	7 lbs.
Dimensions:	
Height	4.6 in.
Width	9.4 in.
Length	10.4 in.

E *Table 1-14. Reflex Sight Characteristics*

Weight:	6.0 lbs.
Dimensions:	
Height	10.25 in.
Width	7.25 in.
Length	8.0 in.

Table 1-15. Pressure Transducer Characteristics

Accuracy:	
Air speed:	Tolerance
15-29 knots	+10 knots −15 knots
30-39 knots	±10 knots
40-99 knots	±5 knots
100-200 knots	±3 knots
Temperature range	−67°F (−55°C) to +185°F (+85°C)
Weight:	0.7 lb.

M *Table 1-15.1. Turret Buffer Amplifier Characteristics*

Power requirements:	115 VAC
Weight:	0.9 lbs
Dimensions:	
Height	2.0 in.
Width	2.4 in.
Length	4.9 in.

M *Table 1-15.2. Logic Relay Assembly Characteristics*

Power requirements:	
Input:	28 Vdc
Weight:	5.6 lbs
Dimensions:	
Height	2.75 in.
Width	7.25 in. (total with relays installed)
Length	12.0 in. (total with connector bolt included)

Table 1-16. Identification Plates

ADAPTER, RECOIL MECHANISM	On cylinder housing near end cap
CONTROL UNIT, EMER STOW	On left side of case
FEED ASSY, AMMO	On top, aft, left corner of cover assembly
FEEDER ASSY, DE-CLUTCHING: M89E1	On T-bar guide rail assembly
GAGE, PRELOAD, RECOIL ADAPTER	On base plate under gauge screw
GUN CONTROL ASSEMBLY	On left side of case
GUN DRIVE ASSY	On end cover to left of drive motor
GUN, 20 MM, AUTOMATIC: THREE BARREL, HIGH RATE, M197	On end plate
IFCU	On panel below connector
LOGIC CONTROL UNIT ASSEMBLY	On rear panel
SLIDER ASSY	On cylinder housing near spindle butt end
TURRET ASSEMBLY	On forward right side of lower support
TURRET CONTROL ASSEMBLY	On side panel below and right of meter
BORESIGHT KIT, UNIVERSAL, UTS	On top center of cover

CHAPTER 2
GROUND CREW OPERATIONAL INSTRUCTIONS

Section I. SERVICES UPON RECEIPT OF MATERIEL

2-1. General. When a new or reconditioned turret system is received, the using organization must determine the system is complete; has been properly prepared for service by the preparing activity; and if the system is capable of performing its mission.

2-2. Inspecting, Servicing, Installing, and Setting-Up Instructions. The turret system will be checked out with the aid of the Electronic System Test Set XM137, lubricated in accordance with LO 9-1090-206-12, and then boresighted in accordance with instructions contained in this manual.

Section II. BORESIGHT ALIGNMENT

2-3. General. A quick check of weapon baseline to sight optics is contained in this section to determine whether or not the turret system must be boresighted.

2-4. Quick Check Boresight.

a. The flight line check of boresight will require three targets which are at least one mile away. These targets will be located approximately in the position shown in figure 2-1. There is no need to level the aircraft as long as the target can be seen through the borescope as the weapon is moved in azimuth.

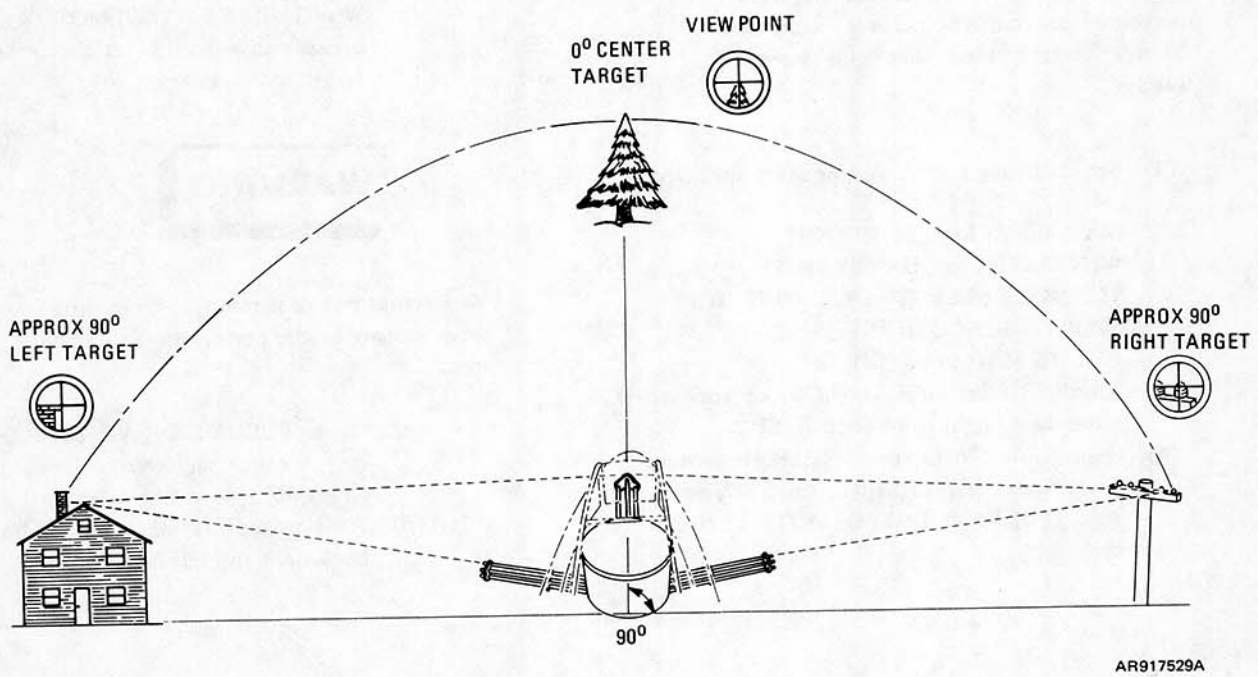


Figure 2-1. Target Selection Boresight Check

WARNING

Before starting quick check boresight procedures, verify that gun and feed system are free of ammunition. No ammunition will be left in the feed system or gun during boresight checks.

NOTE

To obtain greater consistency during check, mark and use the same barrel throughout the procedure.

b. To perform a quick check boresight, proceed as follows:

(1) Clear system of ammunition in accordance with paragraph 2-7.
(2) Check muzzle clamp for proper torque; 750 to 950 lb-in.
(3) Perform aircraft setup as defined in table 3-4.

WARNING

Prior to applying electrical power, clear turret area of any obstructions and warn personnel to stand clear. Erect a safety barrier around area that gun barrels sweep.

(4) Set following switches in position specified.

MASTER ARM to STBY (PCP)
WPN CONTR to GUNNER (PCP)
TCP MODE SELECT to TSU/GUN (TCP)
STOW/TRK/ACQ to TRK (SHC)
HI/LOW MAG to HI (LHG)

(5) Align TSU line-of-sight (LOS) to forward target using sight hand control (SHC).
(6) Depress left-hand grip ACTION switch. After turret has aligned to the TSU, disengage TURRET DRIVE MOTOR circuit breaker.

WARNING

Verify that power is removed from turret drive motors before performing following step.

(7) Using telescope contained in universal boresight kit, check that weapon firing barrel is aligned to forward target.
(8) Reengage TURRET DRIVE MOTOR circuit breaker. Repeat steps (5) through (7) using the right target and left target.
(9) If boresight difference exceeds 5 mils, boresighting must be accomplished between the TSU and turret.

NOTE

If boresight and harmonization is required from step (9), it is not necessary to perform steps (10) through (12). This is because TSU to turret adjustment may cause helmet sight boresight to change.

(10) Perform gunner helmet sight boresight check as follows:
(a) Set TCP MODE SELECT switch to OFF.
(b) With TURRET DRIVE MOTOR circuit breaker closed, align reticle to forward target.

WARNING

Verify that power is removed from turret drive motors before performing following step.

(c) Open TURRET DRIVE MOTOR circuit breaker and verify firing barrel aligns to forward target.
(d) Repeat steps (a) through (c) but use both right and left targets.

(e) If data acquired for boresight exceeds 5 mils in any target, boresight of gunner helmet sight must be accomplished.

(11) Perform pilot helmet sight boresight check as follows:

(a) Position WPN CONTR switch to PILOT on pilot control panel.

(b) With TURRET DRIVE MOTOR circuit breaker closed, align reticle to forward target.

WARNING

Verify that power is removed from turret drive motors before performing following step.

(c) Open TURRET DRIVE MOTOR circuit breaker and verify firing barrel is within 5 mils of commanded position.

(d) Perform step (b) and (c) while using right and left targets.

(e) If data indicates that weapon exceeds commanded alignment by more than 5 mils in any target position, pilot helmet sight boresight must be performed.

(12) Perform pilot fixed sight alignment check as follows:

(a) Close TURRET DRIVE MOTOR circuit breaker and position WPN CONTR switch on pilot control panel to FIXED.

WARNING

Verify that power is removed from turret drive motors before performing following step.

(b) Open TURRET DRIVE MOTOR circuit breaker and verify that weapon firing barrel is aligned to within 2 mils of target seen through pilot reflex sight.

(c) If this alignment is not achieved, FIXED FORWARD alignment must be accomplished. Refer to next higher maintenance level.

(13) Remove power from the system and aircraft.

Section III. OPERATIONAL CHECKS AND SERVICES

2-5. General. This section provides instructions for preflight, prefire, and postflight checks and instructions for loading and unloading the turret ammo feed system.

2-6. Preflight Check. This preflight is to check the basic operational status of turret subsystem and its interaction with the remaining subsystem components. These tests are to verify the weapon will fire when commanded during the flight and that all operational modes are functional. Specific details such as slew rates, pointing accuracy, SCAS corrections, firing rate, burst limit, and the like are not verified.

a. Perform FIXED FWD check. Refer to Chapter 3, table 3-5, step 1.

b. Perform gunner helmet control operation. Refer to Chapter 3, table 3-5, step 4.

c. Perform pilot helmet control operation. Refer to Chapter 3, table 3-5, step 4.

d. Perform TSU to turret operation. Refer to Chapter 3, table 3-5, steps 2 and 3.

e. Perform PLT ORIDE operation. Refer to Chapter 3, table 3-5, step 6.

f. Perform weapon cycling check. Refer to Chapter 3, table 3-5, step 1.

g. Perform EMERGENCY STOW OPERATION. Refer to Chapter 3, table 3-5, step 7.

2-7. Postflight Check.

WARNING

Gun barrels may be hot.

a. Perform safing inspection in accordance with figure 2-2.

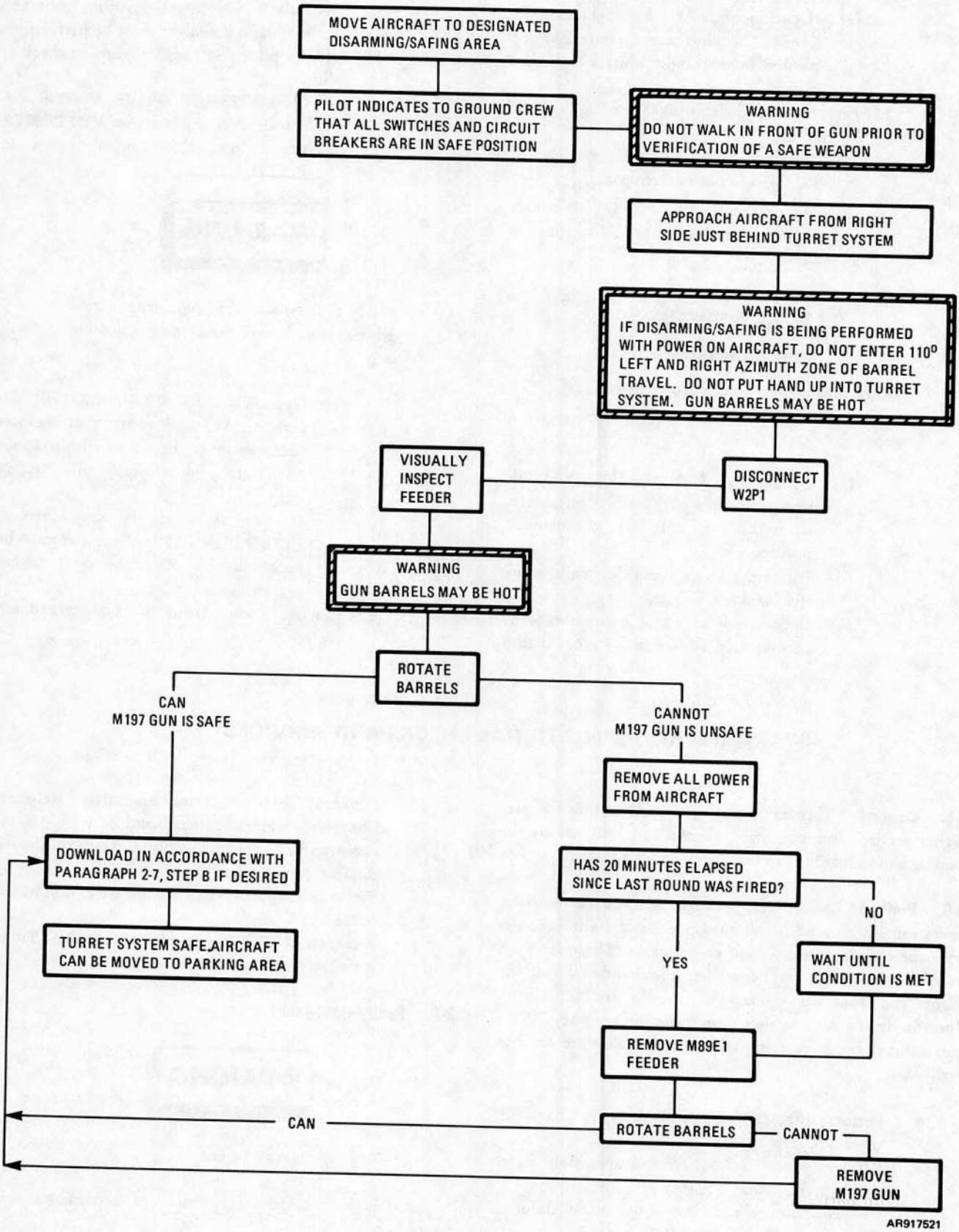


Figure 2-2. Safing Inspection Chart

WARNING

Keep fingers and foreign material clear of feed chute, M197 gun, and M89E1 feeder.

b. When M197 gun is safe, proceed with downloading as follows:

WARNING

Observe all precautions governing care and handling of live ammunition.

(1) Remove feed chute from feeder and break ammunition belt at end of feed chute.

(a) If rounds remaining indicator indicates 100 rounds or less, use AMMO LOAD switch to empty ammunition box. Do not allow ammunition belt to drop on ground.

WARNING

Exercise care when performing following step. A fully loaded ammo bay weighs approximately 500 pounds.

(b) If rounds remaining indicator indicates more than 100 rounds, break ammunition belt at booster end, disconnect booster cable from aircraft connector 19E1J1 and remove ammunition box. Clear feed chute by removing rounds from feeder end.

WARNING

Gun barrels may be hot.

(2) Exercise care that last round in M89E1 feeder is on T-bar guide rail (fig. 2-3). Cycle M197 gun by rotating barrels while depressing feeder solenoid until all rounds have been ejected from M197 gun.

2-8. Loading Feed System With a Full Complement of Ammunition.

WARNING

Observe all precautions governing care and handling of live ammunition. Make certain cable W2P1 is disconnected from W3J1.

CAUTION

In order to achieve reliable operation of the ammunition feed system, each box of linked ammunition must be subjected to a free hinging test prior to loading. The linked ammunition must also be inspected at the same time for long or short rounds and deformed, stretched, or stiff links. Mislinked rounds must be relinked and defective links must be replaced.

a.1 Depress two latches on both left and right ammunition compartment access doors and lower to horizontal position. Disconnect ammunition chute from booster and W1 cable from booster and aircraft.

a.2. Remove four pins from track and place so they will not interfere with ammunition box sliding in tracks.

a.3. Place ammunition box (with booster motor to rear) on the right hand access door and position on track provided for sliding ammunition box in and out of compartment.

a.4. Release fasteners on both sides of box and remove bellmouth and box cover; then fold up shelf-like flaps in all three bays.

a.5 Perform a free hinging belt test (fig. 2-3.1) on each box of linked ammunition. Test will be performed with open side of link up and repeated with open side of links down prior to loading any ammunition into ammunition feed system.

b. Place first linked round, double end first, link down, in bay 1, against crossover bulkhead of ammunition box (fig. 2-4).

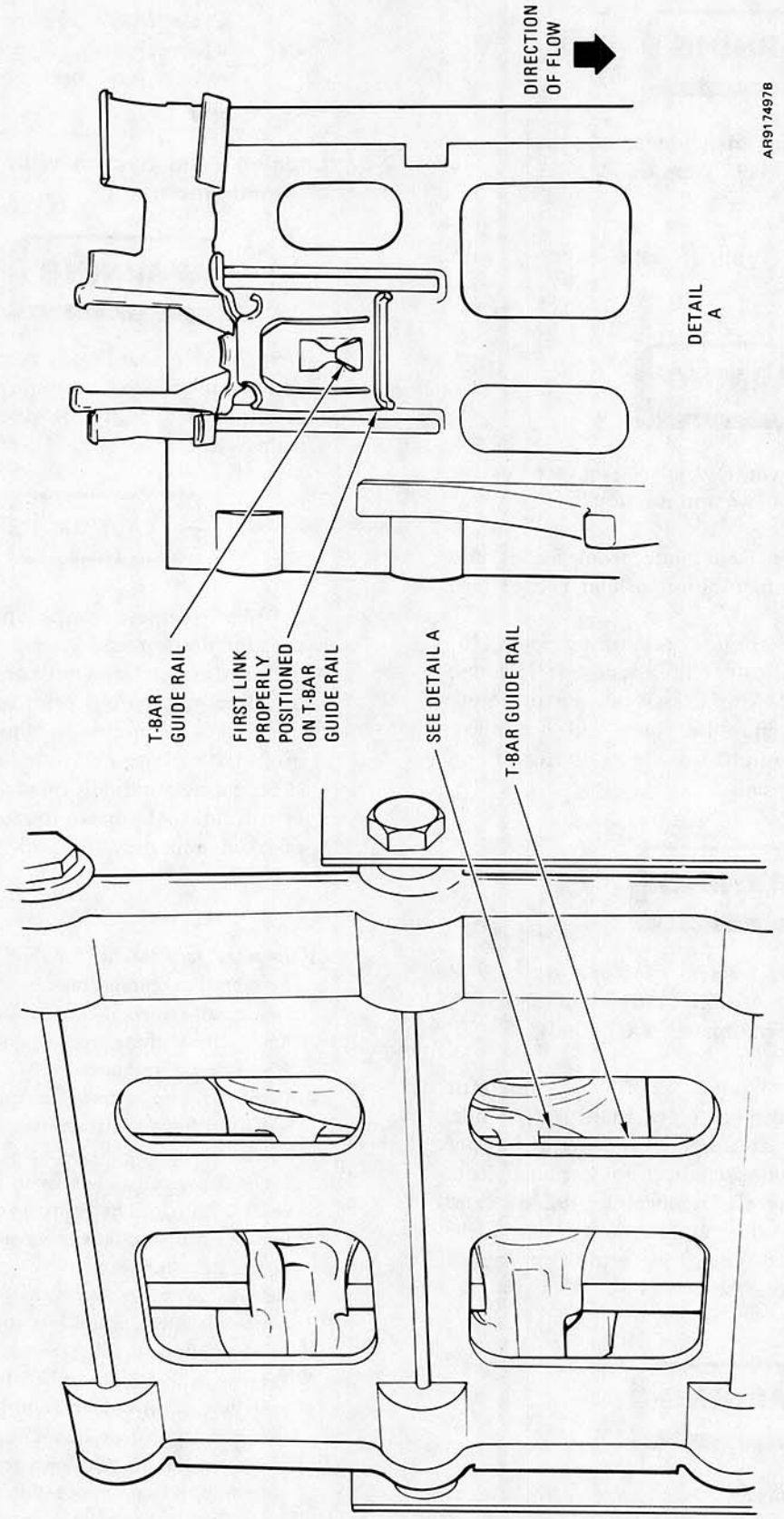
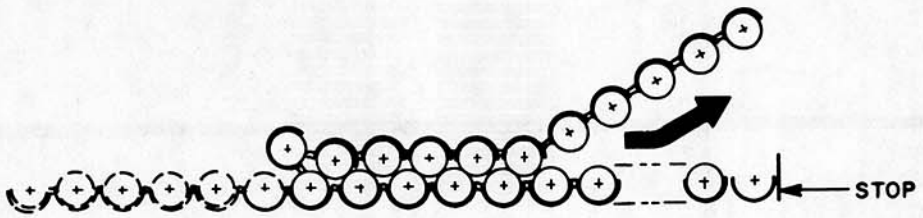


Figure 2-3. First Link of Ammunition Belt Shown Properly Positioned on Feeder T-Bar Guide Rail



OPEN SIDE OF LINKS UP

SCHEMATIC DIAGRAM FOR FREE HINGING TEST

BELTS SHALL HINGE FREELY AND FOLD OVER SMOOTHLY WITHOUT KINKING WHEN BELT IS PULLED IN A LINE AS SHOWN IN DIAGRAM UNTIL BELT IS COMPLETELY REVERSED.
INSPECT FOR LONG OR SHORT ROUNDS AND DEFORMED, STRETCHED, OR STIFF LINKS. RELINK ANY MISLINKED ROUNDS. REPLACE ANY DEFECTIVE LINKS.

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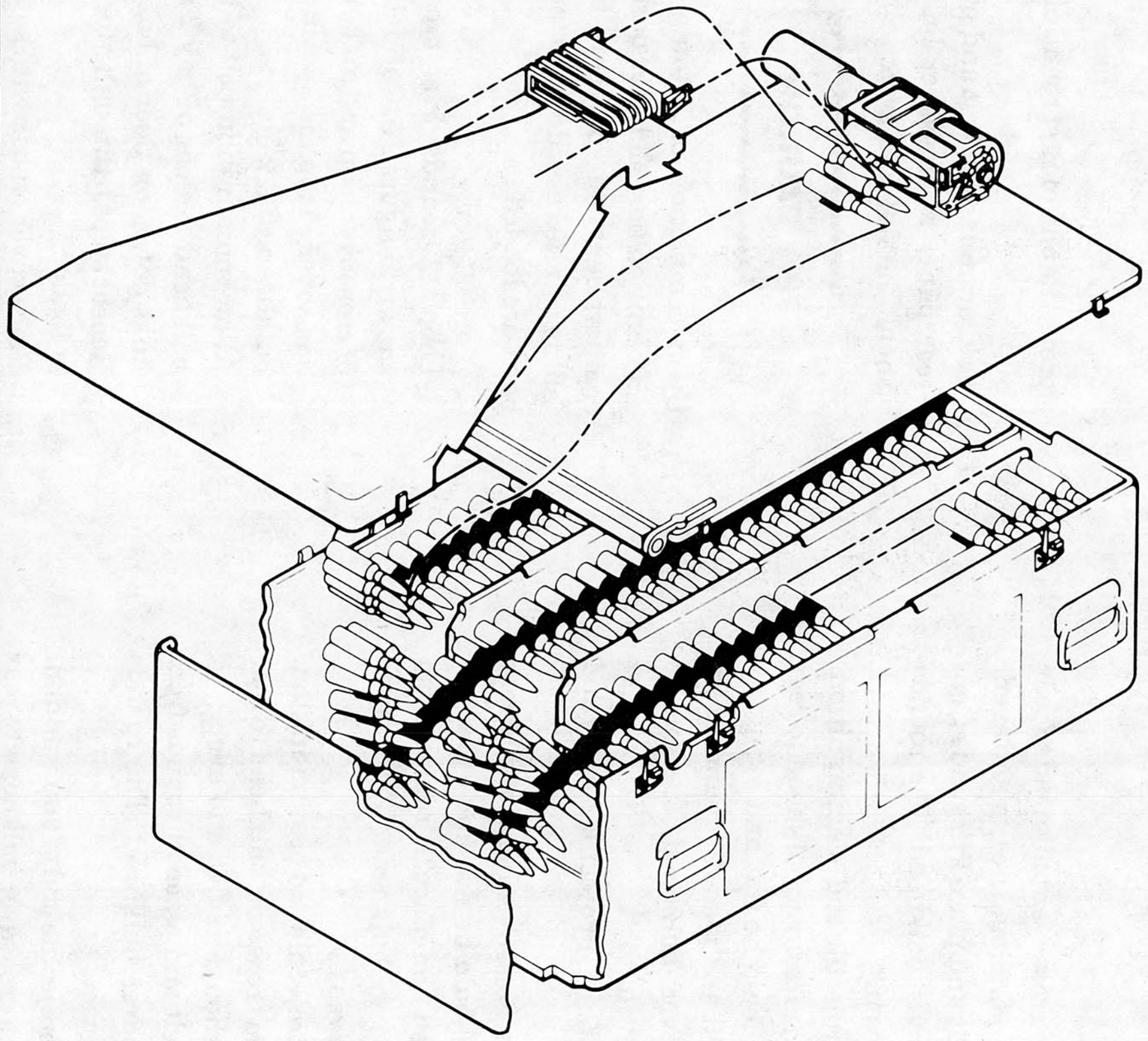
Figure 2-3.1 Linked Ammunition Free Hinging Test

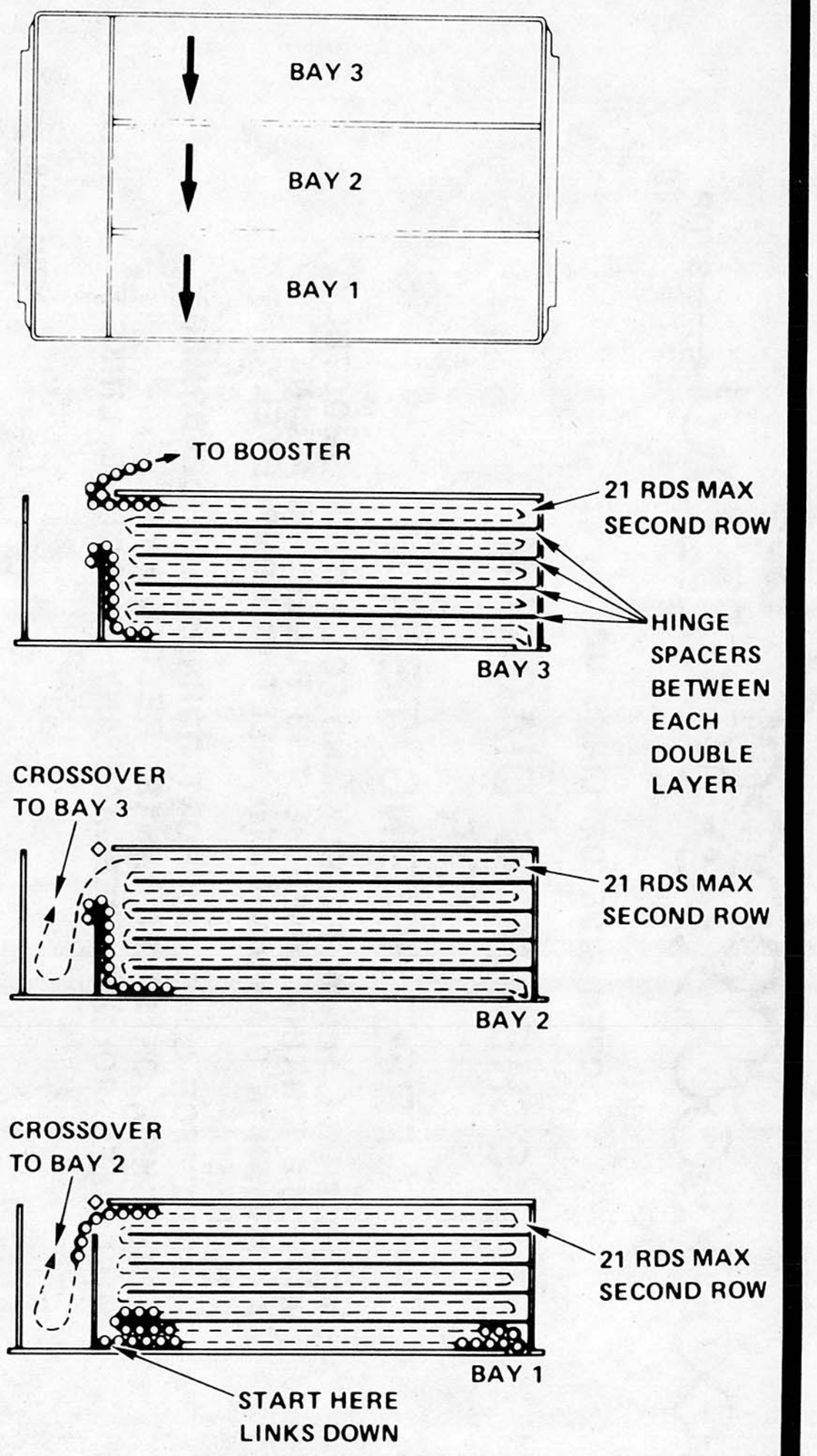
c. Place 21 rounds from crossover bulkhead to rear panel of box. The rounds should lie flat and even.
d. Fold ammunition belt and place 21 rounds from rear panel to crossover bulkhead. The rounds should lie flat and even.
e. Fold down flap on projectile end of ammunition.
f. Place 21 rounds from crossover bulkhead to rear panel. The rounds should lie flat and even.
g. Fold ammunition belt and place 21 rounds from rear panel to crossover bulkhead. The rounds should lie flat and even.
h. Fold down flap on projectile end and ammunition.
i. Place 21 rounds from crossover bulkhead to rear panel. The rounds should lie flat and even.
j. Fold ammunition belt and place 21 rounds from rear panel to crossover bulkhead. The rounds should lie flat and even.
k. Fold down flap on projectile end of ammunition.
l. Place 21 rounds from crossover bulkhead to rear panel. The rounds should lie flat and even.
m. Fold ammunition belt and place 21 rounds from rear panel to crossover bulkhead. The rounds should lie flat and even.
n. Fold down flap on projectile end of ammunition.
o. Place 21 rounds from crossover bulkhead to rear panel. The rounds should lie flat and even. Place projectile end of 21st round of this layer in spring clip.
p. Fold ammunition belt and place 21 rounds from rear panel to crossover bulkhead. The rounds should lie flat and even.

CAUTION

Upon completion of loading bay 1 of ammunition box, slide box partially into compartment to prevent box from falling off access door as succeeding bays are loaded.

q. Loop 12 rounds over crossover bulkhead as shown in figure 2-5. Carefully position 1st round of crossover loop and make certain 12th round of crossover loop is positioned on crossover bulkhead (fig. 2-5).
r. Allow ammunition belt to hang from crossover bulkhead to floor of bay 2 and place 21 rounds, links down, on floor of box.
s. Repeat steps b through r for bay 2 and 3 until box is loaded.
t. Place cover on box with square roller at forward end of box and secure with fasteners.





LOADING DIAGRAM — 20 MM AMMO

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Figure 2-4. Loading Diagram

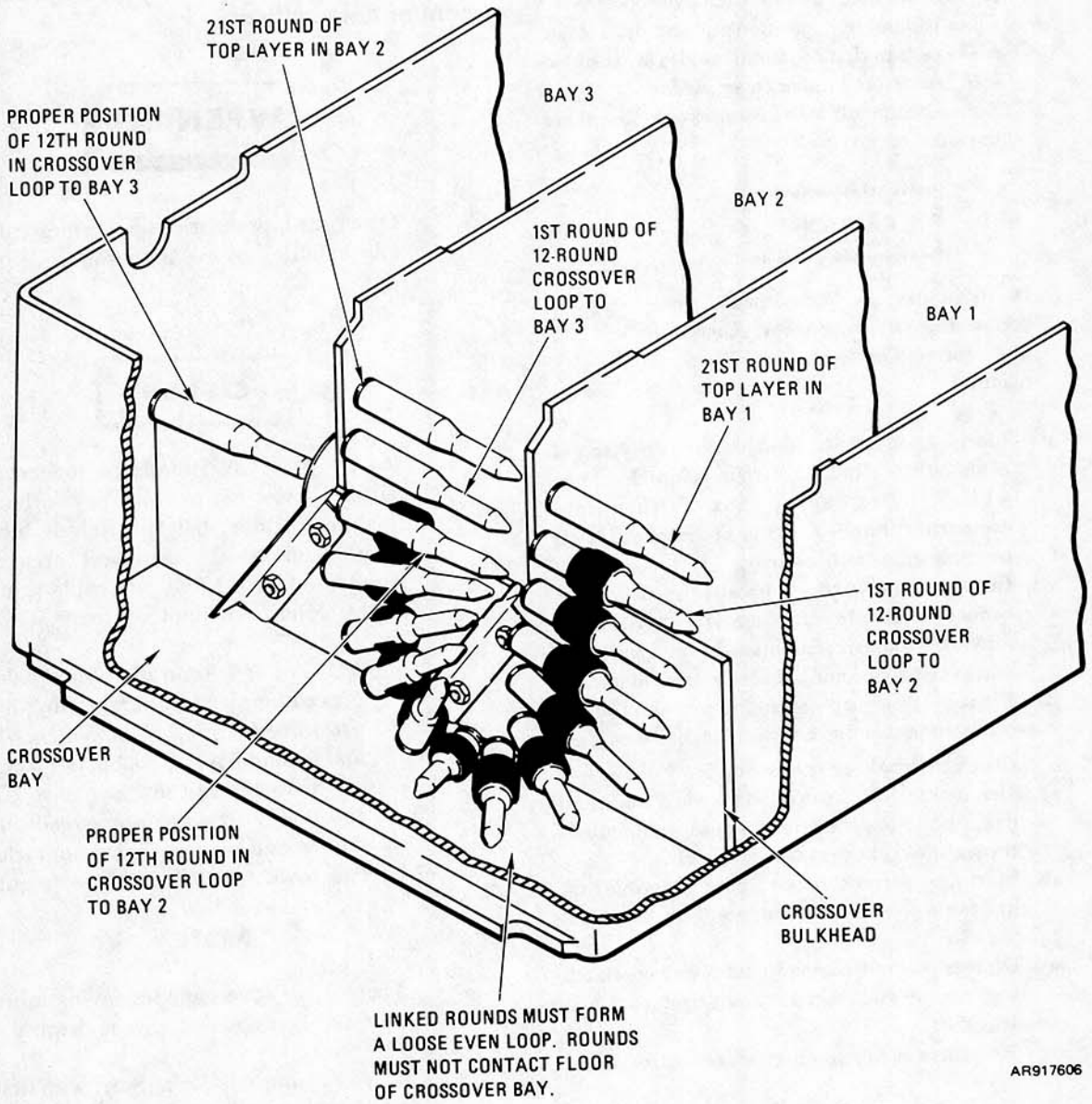


Figure 2-5. Proper Position of 12-Round Crossover Loops in Crossover Bay of Ammunition Box

u. Place ammunition belt out of last bay loaded and lay on box cover. Check that closed side of link is down on top of ammunition box cover.

u.1. Crimp (close up) the leading open link of the ammunition belt sufficiently to hold 20mm round in position and insert round.

v. Feed approximately 20 rounds of ammunition through booster and fold back over booster.

w. Place bellmouth in position and slide into place. Make certain that bellmouth guides are inserted into booster and under cover guides.

x. Secure bellmouth with fasteners provided along the sides of box.

CAUTION

If difficulty is experienced when performing following steps, determine and correct defective condition as required.

y. Place ammunition feed chute on top of bellmouth, feeding the 20 rounds into the chute. while sliding ammo box farther into compartment until two clips on chute will latch securing chute to booster.

y.1. Install ammunition booster cable W1P1 connector to aircraft connector 19B1J1 on forward bulkhead of ammunition compartment and W1P2 connector to booster drive motor.

y.2. Finish pushing ammunition box into compartment and secure with four ball lock pins.

z. Check that battery is connected.

aa. Use ammo load switch on forward bulkhead (right hand lower corner) to push ammunition through feed chute to feeder on gun.

ab. Start first round through feeder, insuring first link tab is properly positioned on T-bar guide rail (fig. 2-3).

ac. Depress core of feeder solenoid to engage clutch and rotate gun barrels until first round is delinked.

ad. Set rounds indicator on gunners control panel.

NOTE

To obtain a fully loaded system a second belt of ammunition may be fed through ammunition chute in Par. y. above and joining the two belts together at booster. Rotate gun barrels (using step ac. above) to take up slack in ammunition belt so that chuting can be secured to booster.

2-9. Loading Feed System With a Partial Complement of Ammunition.

WARNING

Observe all precautions governing care and handling of live ammunition.

CAUTION

At no time will rounds be loaded in either the second or third bay without making certain that the rounds loop down and up the crossover area as shown in figure 2-5. A jam could result if this condition is not verified.

a. *685 to 750-Round Complement.* Follow procedure given in paragraph 2-8.

b. *640 to 684-Round Complement.* Load first and second bays up to, but not including, top two rows. Load third bay as required.

c. *600 to 639-Round Complement.* Load first and second bays up to, but not including, top two rows. Load third bay as required.

NOTE

There is no advantage in leaving more than top two rows of any bay empty.

d. *599 Rounds or Less.* Start with first bay and load normally (leaving top two rows from each bay empty) until desired number of rounds are loaded.

2-10. Unloading. Procedures for unloading are provided as part of the post-flight check. Refer to paragraph 2-7.

CHAPTER 3

AVIATION UNIT MAINTENANCE INSTRUCTIONS

Section I. LUBRICATION INSTRUCTIONS

Refer to LO 9-1090-206-12 for lubrication instructions.

Section II. PREVENTIVE MAINTENANCE CHECKS AND SERVICES

3-1. General. Preventive maintenance is systematic care, inspection, and service of equipment to maintain it in serviceable condition and to detect faults and failures before extensive and time consuming repairs or replacements become necessary.

3-2. Expendable Supplies and Materials. Consumable supplies and materials are listed in Appendix D in alphabetical order. Each consumable has an item number assigned for ease of location and reference. When an item number is unknown you may locate any consumable used in this manual through its alphabetical arrangement. Consumables are referenced in the narrative by name and item number (e.g., epoxy coating item 1, App D).

3-3. Responsibility. Preventive maintenance is a responsibility of aviation unit maintenance and is further defined by unit policies. To make certain that maintenance is accomplished when due, a record of rounds cycled through the turret system must be maintained on DA Form 2408-4.

3-4. Periodic Preventive Maintenance Checks and Services.

a. Preventive maintenance checks and services performed by aviation unit maintenance on the turret system are either time-dependent or rounds-dependent. The schedule prescribed for each check or service will be considered the minimum requirement for system operation under usual conditions. Unusual operating conditions, such as extreme temperatures, dust or sand, moist or salty atmosphere, and rain or snow, require more frequent checks and services. If a preventive maintenance check has not been performed within a 7-day period preceding turret system operation, it will be performed prior to operation.

b. Time-dependent checks and services consist primarily of inspection checks to make certain that the turret system is in an operational condition. These checks and services will normally be performed daily (when the turret system has been operated) or monthly (if the turret system has not been operated).

c. The rounds-dependent checks and services are performed to make certain that parts subject to adjustment variations, wear, or sudden failure are inspected, adjusted, or replaced before overall turret system performance is affected. These checks and services will be performed strictly as scheduled, after the turret system has fired or cycled (as applicable) the number of rounds specified for each item. Rounds cycled through the turret system include those fired, as well as those that are cycled through the gun and ejected unfired.

3-5. Routine Procedures.

a. *Inspections.* Inspections will be made to determine if items are in good condition, correctly assembled or stored, secured, not excessively worn, and adequately lubricated. Any or all of these checks that are pertinent to any item (including supporting, attaching, or connecting members) will be performed automatically as routine procedures in addition to any specific procedures given.

(1) Inspection for "good condition" is usually a visual inspection to determine that the unit is not damaged beyond a safe or serviceable condition. Good condition means that a component or part is not bent or twisted, chafed or burred, bare or frayed, dented or collapsed, torn or cut, or deteriorated.

(2) Inspection of an item to see if it is correctly assembled or stowed is usually a visual inspection to determine that the item is in its normal position and that all of its parts are present and in their correct relative positions.

(3) Inspection of an item to determine if it is secure is usually a visual examination or a check by hand or wrench, for looseness. Such an inspection must include any brackets, locknuts, lockwire, and cotter pins as well as any connecting cables and wires.

(4) "Excessively worn" means worn beyond serviceable limits or to the point likely to result in failure if the item is not replaced before the next scheduled inspection. Refer to the pertinent sections in this chapter

for parts inspection data. It also includes illegible markings, data, identification plates, and printed matter.

(5) When the instruction "tighten" appears in a procedure, it means tighten with the appropriate tool (wrench, screwdriver, etc.), even though the item appears to be secure.

b. *General Cleaning Warnings and Cautions.*

WARNING

Do not use cleaning solvents near an open flame. Fire extinguishers will be available when these materials are used. Use only in well-ventilated areas.

WARNING

Use and disposal of flammable and toxic materials will be in accordance with applicable regulations.

WARNING

Cleaning solvents evaporate quickly and have a drying effect on the skin. Gloves will be worn to avoid cracks in the skin, and in some cases mild irritation or inflammation of the skin.

CAUTION

Petroleum based solvents or vapor degreasers will not be used to clean any parts other than those specified herein. These solvents may cause damage to paint, plastics, and rubber.

CAUTION

Solvents such as acetone, toluene, or trimethylene oxide will not be used to clean polycarbonate (Lexan) ammunition feed system components.

CAUTION

Electrical and electronic components will not be cleaned by immersion.

CAUTION

Recoil adapters will not be cleaned by immersion.

CAUTION

Components that contain bearings will not be cleaned by immersion.

CAUTION

Special attention will be given to components and parts subject to powder residue.

c. *General Cleaning Instructions.*

CAUTION

Do not immerse recoil adapters, bearings, or electrical parts in solvent.

(1) Use solvent (item 6, App D) to clean or remove grease and oil from all metal parts, except those exposed to powder residue. This solvent does not readily dissolve corrosive salts from powder and primer compositions.

(1.1) Use soap and water or solvent (item 6, App D) to clean polycarbonate (Lexan) ammunition feed system components.

(2) Scrub surfaces subjected to powder residue with a non-metallic, bristle brush saturated with solvent cleaning compound (item 5, App D) prior to cleaning with solvent (item 6, App D).

(3) Use a wire brush to remove hard carbon from metallic surfaces not having a protective finish.

NOTE

Cleaning materials are not lubricants. Parts requiring lubrication will be dried and lubricated or preserved in accordance with section I.

(4) Gloves will be worn when handling clean polished parts.

(5) Clean polished parts will be lubricated immediately after cleaning to prevent rusting.

(6) The bore and chamber of each gun barrel will be scrubbed clean using a cleaning staff with a phosphor bronze brush saturated with solvent cleaning compound (item 5, App D). After all deposits have been removed, wipe bore and chamber dry.

(7) When authorized to install new parts, remove any preservative materials such as rust-preventive compound or grease. Lubricate parts requiring lubrication in accordance with Section I of this chapter.

3-6. Specific Procedures. Specific preventive maintenance checks and services to be performed on the equipment are listed in tables 3-1 through 3-3.

a. *30-Day Elevation Drive Clutch Check.* Check elevation drive clutch setting with no power applied to turret system. Apply an upward vertical force at end of barrel cluster. The clutch should not slip with 77 pounds of force applied and should slip when force is increased to 94 pounds. If defective, notify next higher maintenance level to repair/replace clutch.

b. *30-Day Azimuth Drive Clutch Check.* Check azimuth drive clutch setting with no power applied to turret system. Apply a horizontal force at end of barrel cluster. The clutch should not slip with 116 pounds of force applied and should slip when force is increased to 141 pounds. If defective, notify next higher maintenance level to repair/replace.

c. *7-Day Recoil Attenuation System Lubrication.* Apply a coating of grease (item 2, App D) around spindle where it protrudes from recoil adapter housing. Lubricate slider with grease (item 2, App D) utilizing grease fitting in slider housing.

c.1. *5,000-Round Recoil Attenuation System Lubrication.* Lubricate slider in accordance with LO 9-1090-206-12. Notify aviation intermediate maintenance to lubricate recoil adapter in accordance with TM 9-1090-206-30.

d. *30,000-Round Recoil Adapter Preload Check.* The recoil attenuation system has only one active adapter. The active recoil adapter is checked in the recoil adapter preload gage. The gage verifies force versus travel characteristics. Notify next higher maintenance level to perform recoil adapter preload check.

Table 3-1. Preventive Maintenance Checks and Services

NOTE

Within designated interval, these checks are to be performed in the order listed.

B – Before or 1500 Rounds
D – During operation or maintenance task
A – After or 2500 Rounds
W – Weekly or 5000 Rounds
M – Monthly or 15,000 Rounds

Item No.	Interval					Item to be Inspected Procedure	For Readiness Reporting Equipment is Not Ready/ Available if:
	B	D	A	W	M		
1	o					Perform turret system preflight checkout.	Turret system fails preflight checkout.
2		o				Perform turret system functional checkout including boresight.	Turret system fails functional checkout.
3		o				Check turret system dynamic accuracy during firing.	Projectiles do not impact selected target.
4	o					Check operation of feeder solenoid.	Damaged or inoperative.
5					o	Check operation of elevation drive clutch.	Clutch slips or inoperative.
6					o	Check operation of azimuth drive clutch.	Clutch slips or inoperative.
7					o	Check turret harness cables for cut or torn cable covering, missing clamps or ties, damaged connector, bent connector pins.	Damage impairs operation.
8	o		o	o	o	Rotate barrel cluster of M197 gun.	
9					o	Check feed chute for freedom of movement, damaged sections, secure mounting.	Damage impairs operation.
10					o	Check recoil adapter preload or every 30,000 rounds as applicable.	Improper preload.
11					o	Check boresight alignment.	Out of alignment.

Table 3-2. M89E1 Feeder Preventive Maintenance — Rounds Interval

Item No.	Rounds Interval	Item to be Inspected/Procedure
1	Every 9,375	Backlash Pins: Replace backlash pins, springs, and spring pins.
2	Every 9,375	T-Bar Guide: Check rail for excessive wear (edges worn through). Replace if defective.
3	Every 18,750	Stripper: Replace stripper and mounting screws.
4	Every 18,750	Bearing Retainer Mounting Screws: Replace.
5	Every 37,500	T-Bar Guide: Replace.
6	Every 37,500	Wedge: Replace.
7	Every 37,500	Clutch Lock: Replace.
8	Every 150,000	M89E1 Feeder: Replace.

Table 3-3. M197 Gun Preventive Maintenance — Rounds Interval

Item No.	Rounds Interval	Item to be Inspected/Procedure
1	Every 5,000 or less	Barrels: Replacement is determined by bore erosion. A bore erosion check will be performed every 5,000 rounds or less based on the following criteria: a. A bore erosion check will be performed after a long burst (300 rounds or more) or a series of short bursts (totaling 400 rounds in a 10-minute period). b. A bore erosion check will be performed every 1,500 rounds when bore erosion reaches 0.035 inch. Replace barrels when bore erosion reaches 0.050 inch. Restrict burst length on barrels with bore erosion of 0.035 to 0.050 inch to less than 300 rounds in any five-minute period.
2	Every 15,000	Muzzle Clamp Plate: Clean, inspect, and repair or replace as necessary.
3	Every 15,000	Muzzle Clamp Bolt and Self-Locking Nut: Clean, inspect, or replace as necessary. Check breakaway torque of bolt and self-locking nut when muzzle clamp is removed. End of bolt must extend three to five threads beyond end of self-locking nut to obtain a valid torque reading. Replace bolt and self-locking nut if breakaway torque is less than 90 lb-in.
4	Every 15,000	Mid-Barrel Clamps: Clean, inspect, and repair or replace as necessary.
5	Every 15,000 (See Note)	Breech Bolts (PN 11010157): Replace bolt shaft assembly, spring pin, locking block, contact stop, firing pin cam, firing pin, firing pin spring, firing pin insulator, and firing pin cam insulator. These parts are not interchangeable with parts for breech bolt PN 11691422. Mark breech bolts R1 for 15,000-round rebuild and R2 for 30,000-round rebuild.
5.1	Every 15,000 (See Note)	Breech Bolts (PN 11691422): Replace spring pin and locking block. These parts are not interchangeable with parts for breech bolt PN 11010157. Mark breech bolts L1 for 15,000-round maintenance, L2 for 30,000-round maintenance, L3 for 60,000-round maintenance, and L4 for 75,000-round maintenance.
6	Every 15,000	Bearing Retainer: Inspect. If necessary, notify next higher maintenance level to replace. Retorque mounting bolts to 250 to 300 lb-in.
7	Every 15,000	Firing Contact: Clean, inspect, and repair or replace as necessary.
8	Every 15,000	Guide Bar Mounting Spring Pins: Replace.
9	Every 15,000	Gun Housing: Clean and inspect. If necessary notify next higher maintenance level to replace. Retorque upper and lower housing section mounting bolts to 90 to 100 lb-in.
10	Every 15,000	Front Unlocking Cam: Check for proper mounting. Retorque mounting bolts to 250 to 300 lb-in.
11	Every 15,000	Rear Unlocking Cam: Check for proper mounting. Retorque mounting bolts to 250 to 300 lb-in.
12	Every 15,000	Lock Cam Mounting Bolts: Check for damaged or defective threads.
13	Every 15,000	Ball Bearing: Notify next higher maintenance level to lubricate.
14	Every 15,000	Needle Bearing: Notify next higher maintenance level to lubricate.

Table 3-3. M197 Gun Preventive Maintenance — Rounds Interval — Continued

Item No.	Rounds Interval	Item to be Inspected/Procedure
15	Every 15,000	Laminated Shim: Notify next higher maintenance level to inspect.
16	Every 15,000	Rotor Gear: Notify next higher maintenance level to inspect gear and to retorque mounting screws to 30 to 40 lb-in.
17	Every 30,000	End Plate: Notify next higher maintenance level to clean, inspect, and repair or replace as necessary.
18	Every 30,000	Firing Contact: Replace.
19	Every 30,000	Gun Housing: Replace spring pins used to position upper and lower housing sections.
20	Every 30,000	Rotor: Notify next higher maintenance level to visually inspect rotor for defects; to replace bolt head locks, RH front tracks, LH front tracks, front track mounting bolts, and front track screws; to clean, inspect, and repair or replace doubler plate, doubler plate mounting screws, leaf springs, and rotor stops as necessary; and to clean and inspect needle bearing.
21	Every 30,000	Indexing Pin: Clean, inspect, and repair or replace as necessary.
22	Every 45,000 (See Note)	Breech Bolts (PN 11010157): Replace.
22.1	Every 45,000 (See Note)	Breech Bolts (PN 11691422): Replace bolt shaft assembly, spring pin, locking block, plug, cam pin, firing pin, firing pin spring, horizontal insulator and vertical insulator. Mark breech bolts R1 for 45,000-round rebuild.
23	Every 45,000	Bearing Retainer: Notify next higher maintenance level to clean, inspect and repair or replace bearing retainer as necessary and to replace mounting bolts.
24	Every 45,000	Coupling Clamp: Check for proper mounting. Retorque nut to 90 to 100 lb-in.
25	Every 45,000	Firing Contact: Replace mounting screws.
26	Every 45,000	Guide Bar: Replace guide bar and mounting spring pins.
27	Every 45,000	Front Unlocking Cam: Clean and inspect. Replace as necessary. Replace mounting bolts.
28	Every 45,000	Rear Unlocking Cam: Clean and inspect. Replace as necessary. Replace mounting bolts.
29	Every 45,000	Lock Cam: Replace lock cam and mounting bolts.
30	Every 45,000	Center Tracks: Notify next higher maintenance level to replace center tracks and mounting bolts.
31	Every 45,000	Removable Tracks: Notify next higher maintenance level to replace removable tracks and to inspect removable track spacers, track lock pins, and retaining rings.
31.1	Every 90,000	Breech Bolts (PN 11691422): Replace breech bolts unless M197 gun is also due for 90,000 round replacement.

Table 3-3. M197 Gun Preventive Maintenance — Rounds Interval — Continued

Item No.	Rounds Interval	Item to be Inspected/Procedure
32	Every 90,000	M197 Gun: Replace NOTE Service breech bolts in accordance with 15,000/45,000-round interval requirements upon removal from M197 gun. Mark breech bolts as used parts and indicate remaining rounds service life. Identify breech bolts as a set and store together until required for installation; these parts will be installed only as a set. Breech bolts PN 11010157 and PN 11691422 will not be intermixed as a set. After installation, continue to service breech bolts in accordance with scheduled maintenance requirements.

Section III. SYSTEM TESTING AND TROUBLESHOOTING

3-7. Turret System Checkout and Fault Isolation.

a. The checkout/fault isolation procedures are in tabular form. The tables provide a functional check of the turret system while mounted in the aircraft, and fault isolation to the removable component assembly level. Before starting any test or applying power to the turret system, make sure that all turret related circuit breakers (table 3-4) are set to off. To perform checkout/fault isolation procedures, external power must be applied. The turret system checkout procedures include troubleshooting instructions as an aid in isolating and correcting malfunctions. In using these tables for checkout purposes, it will not be necessary to go beyond the test condition and normal indication columns, unless an abnormal indication is observed. Should an abnormal indication be observed, there is a listing of the most likely probable causes for that malfunction. The corrective action column indicates the procedure or operation required to correct the malfunction. Table 3-5 procedures may be performed without the use of test equipment. When the system passes all normal indications for each procedural step within the table, confidence in system operation is assured. However, should an abnormal indication be observed during the checkout procedures of table 3-5, it may become necessary to connect the UTS test set to the system or component specified to determine the cause of the listed abnormal indication. Table 3-6 provides the operator with instructions for system checkout using the test set. This table provides the ground crew with a pass or fail, as displayed by the test set indicators, and a readout of a fault code. This fault code has a direct relationship to a specific system test point voltage measurement under specific system mode of operation. A description of that signal and what may cause its failure is presented in table 3-7. As many as 31 system test point voltages are automatically measured and evaluated by the test set. Each of the various test set automatic scanning and evaluation of system voltages is designed so that the primary system functions are evaluated first and the secondary (dependent upon primary) functions occur later in that test sequence. Therefore, if a primary system signal fails to function, all secondary functions which require that first function will also fail. From this it can be seen that the primary function failure must be corrected first. The presentation of the failures (fault codes) by the test set is such that primary and then secondary measurement failures occur in sequence, therefore the operator is instructed to perform corrective actions in a sequence compatible with fault code presentation. In addition, the test set provides the operator with the capability to checkout each of the line replaceable electronic control units of the turret system. This feature allows the operator to perform a functional test of that line replaceable unit (LRU) prior to its removal from the aircraft. This approach minimizes the amount of LRU swapping which normally occurs during fault isolation of relatively sophisticated and interrelated system components. This method of fault isolation also provides the operator with direction to faulty aircraft wiring and certain turret system components which may require a simple adjustment procedure. The test set also has the ability to display system test point voltages as a conventional digital voltmeter. This feature of test set operation is extremely useful when intermittent or time related malfunctions occur. Table 3-8 contains the keyboard entry requirements and signal description with its nominal test set display indications for various system operating conditions.

b. The turret can be controlled by the test set in the event of an interface control unit failure or the lack of a functional sighting mechanism (helmet sight subsystem or TSU). The test set bypasses the above system components, and exercises the turret by using the sight simulator portion of the test set. This allows the continuation of turret checkout should the above units be faulty, and could help minimize "downtime" of the aircraft for weapon system malfunctions. The procedures to bypass the interface control unit and aircraft sighting mechanisms are located in paragraph 3-8.

c. Prior to applying power to the turret system, disconnect turret system cable W2P1 from W3J1 at aft end of the saddle. Read each step thoroughly before proceeding.

WARNING

When directed to connect the test set (XM137) to the turret system, set all power to the turret system to OFF and make sure that cable W2P1 is disconnected from W3J1. Failure to observe this warning may result in injury to personnel or damage to the equipment. Before starting system checkout, either remove barrels from the weapon or erect a barrier on the perimeter of the turret system.

Make sure the gun, feeder, and ammunition box are unloaded and no rounds are remaining in the system. Also make sure all wing stores are downloaded and that no ordnance remains on the aircraft. Refer to TM 9-1090-207-13&P.

All ordnance systems can be fired from the ground by the gunner cyclic stick trigger with the MASTER ARM switch set to OFF if the PLT ORIDE switch is set to PLT ORIDE.

d. When it becomes necessary to connect the test set to the turret system, refer to figure 3-1, which provides the location of cable connections. Connect only those test set cables specified in the procedures. Adjustment procedures are beyond the scope of this manual. Refer to next higher maintenance level.

3-8. Sight Bypass Procedure. This procedure is to be used whenever the sight subsystems are nonfunctional or the interface control unit has been removed from the aircraft and the turret subsystem requires maintenance action. Connection and operation of the test set sight simulator is performed as follows:

WARNING

Erect a safety barrier around area gun barrels sweep.

M CAUTION

Whenever the sight simulator resolvers are used to control the turret position, the turret buffer amplifier must be replaced with the B256-01-05-101 bypass cable.

a. Position the test set on the left hand ammo bay door.

b. Connect cables as follows:

(1.1) **E** Disconnect aircraft connector 22A4P311 from IFCU J311.

(1.2) **M** Disconnect aircraft connectors 19A7P1 and 19A79247 from turret buffer amplifier connectors J1 and J2. Connect jumper cable B256-01-05-101 to connectors 19A7P1 and 19A7P247.

(2) **M** Connect test set cable W21P2 to aircraft connector 22A4P13, test set cable W21P3 to aircraft connector 22A4P15, and test set cable W21P1 to test set cable W15P2.

(3) **M** Disconnect aircraft connectors 22A4P13 and 22A4P15 from IFCU J13 and J15.

(4) **M** Connect test set cable W15P2 to aircraft connector 22A4P311.

(5) Connect W15P1 to test set connector J2.

c. Position the AZ and EL dials on the test set to 0°.

d. Set the turret system switches and circuit breakers as defined in table 3-4.

NOTE

The sight simulator in the test set is designed such that the power cable need not be connected. Power for the resolver and associated electronics is supplied from the system via the W15 cable assembly. Any use of the test set other than as a sight bypass will require connection of the W1 power cable. Sight bypass operation also prevents inadvertent weapon firing by not allowing the azimuth error interlock to be valid. This feature is indicated by a constant reticle flashing on the test set. Refer to Figure FO-2.

e. Position the following switches as defined below:
 (1) WPN CONTR (PCP) GUNNER
 (2) MODE SELECT (TCP) TSU/GUN

f. On test set, set the ACTION switch to ON.
 (1) Verify the turret slews to the 0° az, 0° el position and that turret position is controlled by the test set resolver dials.

NOTE

Clockwise rotation of the test set AZ resolver dial causes the turret to move to the right. Clockwise rotation of the EL resolver dial results in the turret moving in an upward direction.

 (2) Verify test set resolver dials do not control the turret position when the ACTION switch in test set is set to the OFF position.

NOTE

If the turret operates in the manner described above (steps f(1) and f(2)) the turret subsystem components are functional.

In the event that the system did not operate normally when using either the telescopic sight unit or helmet sight subsystem sighting mechanisms, the most likely faulty component would be the interface control unit.

NOTE

Perform interface control unit checkout per paragraph 3-15. If interface control unit checks ok, refer to appendix A for appropriate manuals for telescopic sight unit or helmet sight subsystem fault isolation.

g. M After completion of test, remove B256-01-05-101 jumper cable and connect aircraft connectors 19A7P1 and 19A7P247 to turret buffer amplifier connectors J1 and J2.

3-9. Troubleshooting.

a. Troubleshooting instructions are provided as an aid in isolating and correcting malfunctions that may be encountered during operation of the turret system. The more common and/or representative troubles are listed but similar methods of trouble analysis and remedial action should be used to correct any specific trouble not discussed.

b. Tables 3-9 through 3-11 should be used to locate and correct malfunctions in the M89E1 feeder, M197 gun, and turret system.

NOTE

This illustration shows the location of all test set to aircraft cable conditions and does not imply a particular test configuration. When performing a system test or any component test, connect only those cables specified in the particular test procedure.

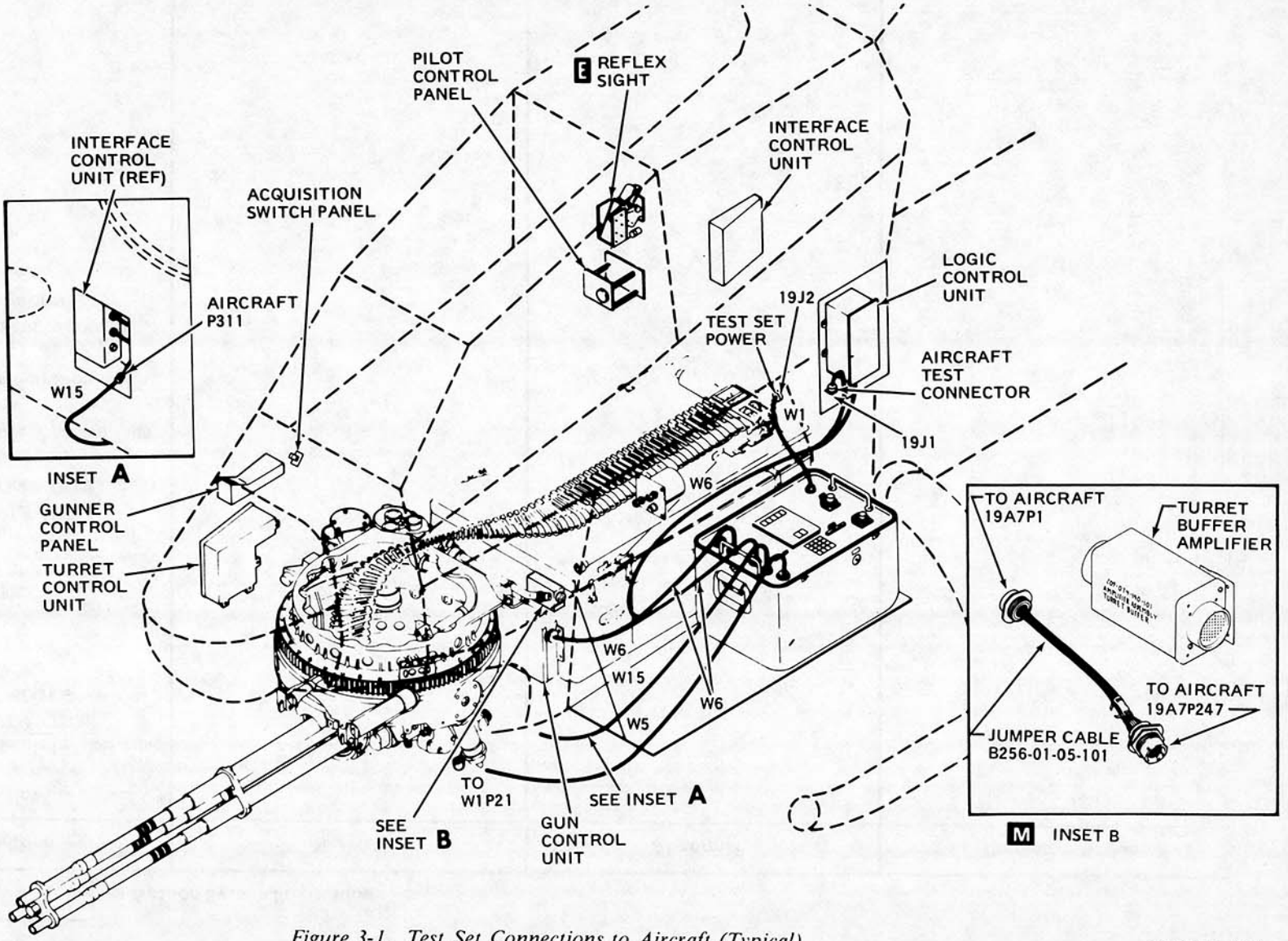


Figure 3-1. Test Set Connections to Aircraft (Typical)

209075-454
AR917344D

Table 3-4. Aircraft Armament Setup Conditions

Step 1	Weapon System Preparation		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
a. Disengage the following circuit breakers: AC and armament circuit breaker panel TURRET DRIVE MOTOR TURRET GUN MOTOR TURRET STOW WPN CONTR WPN FIRE E TURRET CONTR M ARMT CONTR FCC WING STORE PLT JETT WING STORE GNR JETT a.1 Install ground safety pins in each ejector rack. b. Install empty ammunition feed system. c. Check all armament subsystem components for proper installation.			

Table 3-4. Aircraft Armament Setup Condition — Continued

Step 1	Weapon System Preparation — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION Support gun barrels when performing following step to prevent barrels from striking ground. d. Manually release turret elevation and azimuth brakes. Manually slew turret to its extremes to check for obstructions and foreign objects that might impair movement of turret when under power, and might cause damage to the system. When check is complete, set both brakes on. e. Check that 20-mm weapon and feeder are properly timed. f. Deleted.			

Table 3-4. Aircraft Armament Setup Condition — Continued

Step 2	Control Switch Positions		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
a. Set switches on pilot control panel as follows:			
MASTER ARM OFF			
WPN CONTR FIXED			
WING STORE RKT			
RECOIL COMPEN OFF			
HSS RTCL BRT			
RANGE SHORT			
HSS RTCL TEST OFF			
b. Set switches on pilot jettison control panel as follows:			
JETTISON SELECT			
INBD OFF			
OUTBD OFF			
c. Set switches on gunner control panel as follows:			
PLT ORIDE OFF			
WING STORE RKT			
RANGE SHORT			
HSS RTCL BRT			
HSS BIT OFF			
RD RMNG 250			
HSS RTCL TEST OFF			
E A/S COMPEN OFF			
E TURRET DEPR LIMIT ON			
E SLEW RATE SLOW			
M LASER SAFE/ TURRET DEPR LIMIT ON			
M TUR SLEW GRD TEST			
M TSU/GUN SLEW RATE LOW			

Table 3-4. Aircraft Armament Setup Condition — Continued

Step 2	Control Switch Positions — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
d. On TOW control panel set MODE SELECT switch to OFF. d.1 Set switches on gunner jettison control panel as follows: WING STORES JETTISON — OFF JTSN SEL OUTBD/INBD/BOTH — INBD **WARNING** Prior to applying electrical power, clear turret area of any obstruction and warn personnel to stand clear. Erect a safety barrier around area the gun barrel sweeps. e. Verify aircraft battery is connected. f. Apply 28 Vdc external electrical power in accordance with TM 55-1520-236/239-23. g. Deleted			

Table 3-4. Aircraft Armament Setup Condition — Continued

Step 3	Circuit Breaker Positions		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
Engage the following circuit breakers: AC and armament circuit breaker panel SCAS PWR ATTD IND PLT REF XFMR 28 VAC XFMR E GYRO COMP M GYRO CMPS TURRET PWR HSS PWR SECU PWR TMS PWR TURRET DRIVE MOTOR TURRET GUN MOTOR WPN CONTR WPN FIRE E TURRET CONTR M ARMT CONTR DC breaker panel GEN FIELD GEN BUS RESET SCAS PWR E HYD M HYD CONTR DC VM INV CAUT LT PLT INST LT GNR INST LT			

Table 3-4. Aircraft Armament Setup Condition — Continued

Step 4	Power Switch Position		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
Place the following power switches to positions indicated: ALTNR OFF/RESET BATTERY RUN NON-ESNTL BUS MANUAL ELEC PWR/ EMER OFF ELEC PWR			

Table 3-5. System Functional Checkout No Test Equipment

Step 1	GHS, PHS, and Fixed Forward Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
a. Perform aircraft armament setup conditions in table 3-4. **NOTE** Two personnel should be used for helmet sight check, one in the pilot seat and one in the gunner seat. b. Connect pilot and gunner helmet sight linkages to the BIT brackets at the forward support points.			**M CAUTION** When procedures indicate that a logic relay assembly should be checked, a known good unit must be substituted for the suspected unit and test rerun to verify unit is faulty. When it is indicated that the turret buffer amplifier should be checked, a known good unit or a bypass cable which eliminates the unit from the system should be substituted and test rerun. Bypass cable should not be used when Fire Control Computer is in operation.
c. On pilot control panel set MASTER ARM switch to STBY.	c. STBY indicator illuminates.	c. STBY indicator does not illuminate.	c. **M** Check logic relay assembly.
d. Momentarily position the HSS BIT switch on the gunner control panel to BIT.	d. A GO indication appears on gunner control panel in approximately 2 seconds.	d. The GO indication does not appear.	d-1a. Press-to-test HSS BIT indicator for faulty lamp(s). d-1b. Perform checkout of gunner control panel per paragraph 3-16. d-1c. Check HSS subsystem per TM 9-1270-212-14&P.
e. Connect pilot and gunner helmet sights.			
f. Check pilot and gunner helmet linkage for freedom of movement.	f. Linkage should slide freely on rails.	f. Binding in linkage.	f. Check HSS subsystem per TM 9-1270-212-14&P.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 1	GHS, PHS, and Fixed Forward Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
g. Check that HSS reticle BRIGHTNESS control on gunner control panel is functioning properly by varying control.	g. Reticle should be on steady and intensity should vary with control changes.	g-1a. Brightness does not vary. g-1b. Reticle not illuminated.	g-1a. Check bulb. If OK, check brightness control potentiometer 17R2. Refer to paragraph 3-16 step d(10)(c). g-1b. Perform checkout of IFCU per paragraph 3-15. g-1c. Check GHS reticle wiring in aircraft. Refer to TM 55-1520-236/239-23.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 1	GHS, PHS, and Fixed Forward Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
h. On GCP set BRIGHTNESS control to OFF and set RETICLE TEST switch to TEST.	h. HSS reticle should be on steady.	h. Reticle not illuminated.	h-1a. Perform checkout of gunner control panel per paragraph 3-16. h-1b. Perform checkout of IFCU per paragraph 3-15. h-1c. Check reticle test wiring in aircraft. Refer to TM 55-1520-236/239-23.
i. Set RETICLE TEST switch to OFF and readjust BRIGHTNESS control to desired brightness.			
j. Check that HSS reticle BRIGHTNESS control on pilot control panel is functioning properly by varying control.	j. Reticle should be on steady and intensity should vary with control changes.	j-1a. Brightness does not vary. j-1b. Reticle not illuminated.	j-1a. Check bulb. If ok, refer to paragraph 3-17. j-1b. Perform checkout of IFCU per paragraph 3-15. j-1c. Check PHS reticle wiring in aircraft. Refer to TM 55-1520-236/239-23.
k. On PCP set BRIGHTNESS control to OFF and set RETICLE TEST switch to TEST.	k. HSS reticle should be on steady.	k. Reticle not illuminated.	k-1a. Perform checkout of pilot control panel per paragraph 3-17. k-1b. Perform checkout of IFCU per paragraph 3-15. k-1c. Check reticle test wiring in aircraft. Refer to TM 55-1520-236/239-23.
l. Set RETICLE TEST switch to OFF and readjust BRIGHTNESS control to desired brightness.			
m. Position pilot MASTER ARM switch to ARM.	m-1. Turret slews to 0° el, 0° az after approximately 3.5 seconds.	m-1a. Turret moves to a position other than 0° el, 0° az.	m-1a. Perform system checkout procedures in table 3-6 test condition column, substeps 1 through 16. m-1a(1) **M** Check turret buffer amplifier.
		m-1b. Turret oscillates.	m-1b. Check appropriate tachometer per table 3-6 test condition column, substep 16.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 1	GHS, PHS, and Fixed Forward Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
m. Cont.		m-1c. Turret does not move.	m-1c. Perform system checkout per table 3-6. m-1c(1) **M** Check turret buffer amplifier. m-1c(2) **M** Check logic relay assembly.
		m-1d. Turret oscillates for approximately 3 seconds.	m-1d. Faulty gun control unit; replace.
	m-2. PILOT IN CONT indicator illuminates on gunner control panel.	m-2. Indicator does not illuminate.	m-2a. Check lamp. m-2b. Perform checkout of gunner control panel per paragraph 3-16. m-2b(1) **M** Check logic relay assembly. m-2c. Check aircraft wiring in TM55-1520-236/239-23.
	m-3. ARM indicator illuminates on both gunner and pilot control panels.	m-3. One or both indicators fail to illuminate.	m-3a. Check applicable lamp. m-3b. Perform control panel test per paragraph 3-16 or 3-17. m-3b(1) **M** Check logic relay assembly. m-3c. Check aircraft wiring in TM 55-1520-236/239-23.
	m-4. **E** Reticle in pilot fixed sight on steady.	m-4a. **E** Reticle not on.	m-4a. **E** Adjust brightness control and/or check bulb.
		m-4b. **E** Reticle flashing.	m-4b. **E** Faulty reticle bypass relay K101. Check aircraft wiring in TM 55-1520-236-23.
n. While depressing pilot cyclic grip action switch, move pilot helmet sight in small excursions. Excessive downward movement could cause barrels to strike ground if system is malfunctioning. Release action switch.	n. Turret remains at fixed forward position and does not track helmet sight.	n. Turret tracks pilot helmet sight.	n-1. De-energize system and connect test set cables W1 and W6 between system and test set. Reapply power and observe DVM codes 59 (pilot signal) and 76 (TOW signal). Both should be 0 on test set REFERENCE display. If not, check aircraft wiring.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 1	GHS, PHS, and Fixed Forward Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
n. Cont.			n-2. Test IFCU per paragraph 3-15 if step c-1 above checks ok.
o. While depressing gunner cyclic grip action switch, move gunner helmet sight in small excursions. Excessive downward movement could cause barrels to strike ground if system is malfunctioning. Release action switch.	o. Turret remains at fixed forward position and does not track helmet sight.	o. Turret tracks gunner helmet sight.	o. Check aircraft wiring in TM 55-1520-236/239-23.
p. On TCP set MODE SELECT switch to TSU/GUN. On SHC set STOW/TRACK/ACQ switch to TRACK.			
q. While depressing TSU LHG action switch attempt to move turret with TSU in small excursions. Excessive downward movement could cause barrels to strike ground if system is malfunctioning. Release action switch.	q. Turret remains at fixed forward position and does not track TSU.	q. Turret tracks TSU commands.	q-1. Perform checkout of IFCU per paragraph 3-15. If pass results on IFCU, test TCU per paragraph 3-13. q-1(1) **M** Check logic relay assembly. q-2. Check aircraft wiring in TM 55-1520-236/239-23.
r. On TCP set MODE SELECT switch to OFF. On SHC set STOW/TRACK/ACQ switch to STOW.			
s. Momentarily depress pilot cyclic grip action and trigger switches.	s-1. Gun rotates.	s-1. Gun fails to rotate.	s-1a. Perform checkout of gun control unit per paragraph 3-12. s-1b. Check gun drive shear pins. s-1c. Check aircraft TURRET GUN MOTOR circuit breaker (19CB8). s-1c(1) **M** Check logic relay assembly. s-1d. Replace gun drive assembly.
	s-2. Feeder solenoid engages.	s-2. Solenoid does not engage.	s-2. Perform system checkout procedures in table 3-6, step A7.
	s-3. Booster operates.	s-3. Booster does not operate.	s-3. Activate ammo load switch (19S17) to check booster motor. Check aircraft wiring (S17 and CB126) and ammo booster cable.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 1	GHS, PHS, and Fixed Forward Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
s. Cont.	s-4. RD RMNG indicator reads less than 250.	s-4. Indicator does not count down as system cycles.	s-4a. Does the rounds totalizer work? If not, replace rounds sensor switch. s-4b. Check RD RMNG indicator on GCP per paragraph 3-16. s-4c. Check system aircraft wiring on rounds counting signal lead.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 2	TSU Interface and Depression Limit Checks		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION A failure in the depression limit circuit or other elevation drive train failures may result in the gun barrels striking the ground. Exercise care when performing this check. Be prepared to pull TURRET DRIVE MOTOR circuit breaker in the event of failure. Operator has the option of removing the gun barrel cluster before this check.			
a. On TCP set the MODE SELECT switch to TSU/GUN. b. On the pilot control panel set WPN CONTR switch to GUNNER.	b-1. Turret moves to 0° az, +11° el and remains steady. b-2. PILOT IN CONT indicator extinguished.	b-1. Turret does not move or slews to an incorrect position.	b-1. Perform system checkout procedures in table 3-6 test condition column, substeps 18, 19, and 20. b-1(1) M Check turret buffer amplifier
c. On sight hand control set STOW/TRK/ACQ switch to TRK. d. Position the TSU LOS to approximately 0° az, 0° el with the sight hand control.	d. TSU LOS tracks sight hand control.	d. Cannot position TSU LOS with sight hand control.	d-1. Troubleshoot TSU per TM 9-1425-473 series manuals.
e. On TSU left-hand grip control depress the action switch.	e-1. Turret slews to align with TSU LOS.	e-1. Turret does not align properly.	e-1. Perform system checkout procedures in table 3-6, test condition column, substeps 22, 23, and 24. e-1(1) M Check turret buffer amplifier.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 2	TSU Interface and Depression Limit Checks		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
e. Cont.	e-2. E GUNS flag is steady in TSU FOV. M G battle flag is lit in TSU FOV.	e-2. E GUNS flag is in motion in TSU FOV. M G battle flag is flashing in TSU FOV.	e-2. Connect test set to system and check following interlock signals. These codes are further explained in table 3-8. DVM Code / Signal / Voltage 02 Burst Limit +11.7 18 Az Error +16 31 Rkt L.O. 0 36 Lt Limit +20 37 Rt Limit +20 38 Dn Limit +20 39 Up Limit +20 40 El Error +17
CAUTION An observer should be in position to observe barrel cluster in next step.			
f. Slowly and carefully depress TSU LOS to a point lower than -5° el. Observer shall warn if barrels approach too close to ground.	f-1. Turret follows TSU LOS to approx. -5° el then stops tracking TSU LOS.	f-1. Turret follows TSU LOS beyond -5° el position.	f-1a. Perform checkout of Gunner Control Panel per paragraph 3-16. f-1b. Check aircraft wiring associated with TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch on Gunner Control Panel per TM 55-1520-236/239-23. f-1c. Perform system checkout procedures in table 3-6 test condition column, substeps 26, 27, and 28.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 2	TSU Interface and Depression Limit Checks — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
f. Cont.	f-2. **E** GUNS flag is in motion when turret stops tracking TSU LOS. **M** G battle flag is flashing when turret stops tracking TSU LOS.	f-2. **E** GUNS flag remains steady. **M** G battle flag remains lit.	f-2. Check the same interlock signals listed in step e-2 above.
g. While turret is at -5° el position, depress left-hand grip trigger.	g. Gun does not rotate.	g. Gun does rotate.	g-1. Check that TSU LOS is still below -5° position and; **E** GUNS flag is in motion. **M** G battle flag is flashing. g-2. Perform checkout of gun control per paragraph 3-12. g-3. Perform checkout of logic control per paragraph 3-14. g-3(1) **M** Check logic relay assembly.
h. Move TSU LOS up until: **E** GUNS flag is steady. **M** G battle flag is lit.	h. Turret tracks TSU LOS out of -5° position.		
i. Depress left-hand grip trigger.	i. Gun rotates.	i. Gun fails to rotate.	i-1. Verify that pilot MASTER ARM switch is set to ARM. i-2. Check gun drive shear pins. i-3. Check that aircraft TURRET GUN MOTOR circuit breaker (19CB8) is engaged. i-4. Check left-hand grip trigger switch and associated aircraft wiring in TM 55-1520-236/239-23. Trigger switch can be checked with test set connected to system and DVM code 35 entered. With trigger depressed, test set should display +28 Vdc. i-5. If trigger switch and wiring check good in step i-4 above, perform checkout of gun control per paragraph 3-12.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 2 — **TSU Interface and Depression Limit Checks — Continued**

Test Condition	Normal	Abnormal	Corrective Action
i. Cont.			i-5(1) M Check logic relay assembly.
j. Release left-hand grip trigger and action switches.	j. Turret returns to 0° az, +11° el.		
k. On Gunner Control Panel set: E SLEW RATE to NORM M TUR SLEW to NORM M TSU/GUN SLEW RATE to HIGH			
l. Depress left hand grip action switch. With sight hand control move TSU LOS in small excursions.	l-1. Turret aligns with TSU at a high slew rate. l-2. Turret tracks TSU movement with both moving at high slew rate.	l-1. Turret does not align with TSU at a high slew rate. l-2. Turret does not track TSU movement at high slew rate or TSU does not move at a high slew rate.	l-1. Perform checkout of Gunner Control Panel per paragraph 3-16. l-2a. Perform checkout of Gunner Control Panel per paragraph 3-16. l-2b. Perform checkout of Turret Control Unit per paragraph 3-13. l-2c. Troubleshoot TSU per TM 9-1425-473 series manuals.
m. Release left hand grip action switch.	m. Turret returns to 0° az, +11° el.		
n. On Gunner Control Panel set: E SLEW RATE to SLOW M TUR SLEW to GRD TEST M TSU/GUN SLEW SLEW RATE to SLOW			

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 3 — **TSU Slow Slew and Out-of-Coincidence Checks**

Test Condition	Normal	Abnormal	Corrective Action
a. Verify on gunner control panel that: [E] SLEW RATE is set to SLOW. [M] TUR SLEW is set to GRD TEST.			
b. Use TSU sight hand control to position TSU LOS left to 90° az, 0° el.	b. TSU tracks sight hand control movement.	b. TSU does not move.	b. Troubleshoot TSU per TM 9-1425-473 series manuals.
c. Depress action switch on left-hand grip.	c-1. Turret moves at a slow slew rate to align with TSU LOS.	c-1a. Turret does not move.	c-1a. Perform system checkout procedures per table 3-6 test condition column, substeps 31 through 35.
		c-1b. Turret does not slew at slow rate.	c-1b(1). Check SLEW RATE [E] TUR SLEW [M] switch (19S3) and associated aircraft wiring in TM 55-1520-236/239-23. c-1b(2). Perform checkout of turret control per paragraph 3-13.
		c-1c. Turret does not align with TSU line of sight.	c-1c. [M] Check turret buffer amplifier.
	c-2. [E] GUNS flag is in motion until alignment of gun and TSU LOS occurs and then becomes steady. [M] G battle flag flashes until alignment of gun and TSU LOS occurs and then stays lit.	c-2. [E] GUNS flag does not appear or is steady while out of synchronization condition exists. [M] G battle flag is not lit or is lit while out of synchronization condition exists.	c-2. Check the same interlock signals listed in step 2 e-2 Corrective Action column above.

NOTE

The TURRET STOW circuit breaker on AC circuit breaker panel must be in off position. Otherwise turret will reposition to 0° az, +11° el in next step.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 3	TSU Slow Slew and Out-of-Coincidence Checks — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
d. With TSU LOS and turret synchronized at the left 90° az, 0° el position, disengage TURRET DRIVE MOTOR circuit breaker. **NOTE** An observer should be stationed to observe the LCU indicator lamp. Remove access panel to permit observation of LCU.			
e. Reposition TSU LOS right to approximately 100° az, 0° el using sight hand control.	e. Red indicator on logic control is illuminated and: E GUNS flag is in motion in TSU FOV. M G battle flag is flashing in TSU FOV.	e. One or both indicators give incorrect display.	e-1. Perform system checkout procedures in table 3-6 test condition column, substeps 31 through 35. e-2. Perform LCU checkout per paragraph 3-14.
f. While maintaining TSU LOS at the right 100° az, 0° el position, depress the left-hand grip action and trigger switches to the second detent and engage the TURRET DRIVE MOTOR circuit breaker.	f-1. Turret repositions slowly to align with the TSU LOS. f-2. Gun does not cycle until synchronization occurs.	f-1. Turret repositions too fast. f-2. Gun rotates prior to synchronization. f-3. Gun does not rotate at synchronization.	f-1. Perform checkout of TCU per paragraph 3-13. f-2. Perform checkout of GCU per paragraph 3-12. If GCU checks ok, check LCU per paragraph 3-14. f-3. Raise TSU LOS up above -5° elevation.
g. Release action and trigger switches on left-hand grip.	g. Turret slews to 0° az, 11° el position.		
h. On SHC set STOW/TRACK/ACQ to STOW.	h. TSU stows.		

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 4 — **Gunner and Pilot Helmet Control of Turret**

Test Condition	Normal	Abnormal	Corrective Action
a. While holding gunner helmet sight LOS at 0° az, 0° el depress and hold left-hand grip action switch on TSU. **CAUTION** Failure of the depression limit circuit or other elevation drive train failures could allow barrels to strike ground. An observer should warn if barrels move beyond the -5° el position.	a. Turret aligns with GHS LOS and reticle is on steady.	a-1. Turret does not align properly. a-2. Reticle remains flashing.	a-1. Perform GHS resolver alignment procedures. a-2. Check the same interlock signals listed in step 2e-2. Corrective Action column above.
b. Slowly lower the GHS LOS downward. **CAUTION** If turret elevation drive motor continues to drive after upper mechanical limit is reached in the next step, lower GHS LOS to prevent degradation of elevation clutch.	b. Turret moves to -5° el and stops, and GHS reticle flashes.		

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 4	Gunner and Pilot Helmet Control of Turret — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
c. Slowly rotate GHS LOS upward until turret activates upper limit switch.	c. Turret motor stops driving when upper mechanical limit is reached, and reticle flashes.	c-1. Turret continues to drive against stop. c-2. Reticle does not flash when turret is in upper limit.	c-1. Notify next higher maintenance level to adjust upper limit proximity switch. c-2a. Notify next higher maintenance level to adjust upper limit proximity switch. c-2b. Perform checkout of gun control per paragraph 3-12. c-2c. Check aircraft wiring in TM 55-1520-236/239-23 for up limit switch output to GCU. c-2d. M Check logic relay assembly.
d. Release left hand grip action switch. **CAUTION** Barrels must be removed to check down limit switch.	d. Turret slews to 0° az, +11° el position.		
e. Pull TURRET DRIVE MOTOR circuit breaker. Remove barrels. f. Re-engage TURRET DRIVE MOTOR circuit breaker. g. On gunner control panel set TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch to OFF.			
h. Check down, left and right proximity limit switch operation by moving GHS LOS to the respective positions.	h. Turret should stop driving as each limit is reached, and reticle should flash.	h. Failure to stop driving or reticle fails to flash.	h. Notify next higher maintenance level to adjust the respective proximity limit switch.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 4	Gunner and Pilot Helmet Control of Turret – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
i. On gunner control panel set TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch to ON.			
j. With GHS LOS at 0° az, 0° el set MASTER ARM switch to ARM.	j. ARM indicator on pilot and gunner control panels illuminates.		
k. Depress left-hand grip action and trigger switches.	k. Turret goes to GHS LOS and guns rotate.	k. Gun does not rotate.	k. Perform checkout of gun control per paragraph 3-12. k-1. M Check logic relay assembly.
l. On TOW control panel set MODE SELECT switch to TSU/GUN.			
m. On sight hand control hold the STOW/TRK/ACQ switch to the ACQ position. Rotate GHS in all four directions.	m-1. TSU follows GHS in all directions.	m-1. TSU movements not synchronized with GHS control.	m-1a. Connect test set to system. Check for gunner acquisition signal by entering 69 on keyboard. If 28 Vdc is present, proceed to r-1b. If 0 Vdc is present, check aircraft wiring on gunner acquisition signal. m-1b. Perform checkout of IFCU per paragraph 3-15. m-1c. If IFCU checks satisfactorily, check TMS or HSS per TM 9-1425-473-20 and TM 9-1270-212-14&P, respectively.
	m-2. Turret returns to upper stow position and does not follow HSS or TSU.		
n. Release STOW/TRK/ACQ switch on sight hand control. **CAUTION** If barrels were left installed, excessive downward movement will cause barrels to strike ground.	n. The GHS reticle should retract.	n. Failure of reticle to retract.	n. Substitute another helmet into system and repeat check. If same malfunction occurs, perform checkout of IFCU per paragraph 3-15, or check HSS per TM 9-1270-212-14&P.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 4	Gunner and Pilot Helmet Control of Turret — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
o. With the STOW/TRK/ACQ switch in the STOW position, depress and hold the pilot helmet sight ACQ switch E, position ACQ switch to PHS M. Move pilot helmet, sight in small excursions.	o. The TSU should not follow the pilot helmet sight. The gunner helmet sight reticle should not retract when PHS ACQ switch, is pressed E, or positioned to PHS M.	o. TSU follows PHS movements, or gunner helmet sight reticle retracts upon pressing the PHS ACQ switch E, or positioning to PHS M.	o-1. Connect test set to system. Check for pilot acquisition signal by entering 70 on keyboard. If 28 Vdc is present, perform checkout of IFCU per paragraph 3-15. If 0 Vdc is present, check aircraft wiring on pilot acquisition signal. o-2. Perform checkout of HSS per TM 9-1270-212-14&P.
p. Release PHS ACQ switch E, position to NORM M			
q. Position the STOW/TRK/ACQ switch to TRK.			
r. Depress and hold PHS ACQ switch E, position ACQ switch to PHS M. Move PHS LOS in all directions.	r-1. The TSU tracks PHS in all directions.	r-1. The TSU does not track PHS.	r-1a. Perform checkout of IFCU per paragraph 3-15. r-1b. Perform checkout of HSS per TM 9-1270-212-14&P.
	r-2. The GHS reticle retracts when PHS ACQ switch is pressed E, or positioned to PHS M.	r-2. The GHS reticle fails to retract.	r-2a. Perform checkout of IFCU per paragraph 3-15. r-2b. Perform checkout of HSS per TM 9-1270-212-14&P.
s. Release PHS ACQ switch E, position to NORM M.			
t. On pilot control panel set WPN CONTR to PILOT.			
u. With PHS LOS at 0° az, 0° el depress and hold pilot cyclic stick action switch.	u. Turret aligns with PHS LOS and reticle is on steady.	u-1. Turret does not align properly.	u-1. Perform PHS resolver alignment procedures per TM 9-1270-212-14&P.
		u-2. Reticle remains flashing.	u-2. Check the same interlock signals listed in step 2e-2. Corrective Action column above.
v. Move pilot helmet sight in small excursions.	v. Turret tracks PHS.	v. Turret does not track PHS.	v-1. Perform checkout of IFCU per paragraph 3-15. v-2. Perform checkout of HSS per TM 9-1270-212-14&P. v-3. M Check logic relay assembly.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
w. Momentarily depress pilot cyclic stick trigger switch.	w. Gun rotates.	w. Gun does not rotate.	w. Perform checkout of gun control per paragraph 3-12.
x. Release pilot cyclic stick action switch.	x. Turret returns to stow position.		
NOTE The following items of GSE are required for this check: 1. Gunner Quadrant M1A1, NSN 1290-00-891-9999 2. Airspeed Simulator XM88, P/N 11691520 3. Rounds Fire Simulator P/N 11830648 (Part of XM137 test set, P/N 11831041) 4. Hydraulic Cart, NSN 4933-00-933-4742			
a. Remove right-hand fixed fairing near turret azimuth resolver.			
b. Disengage TURRET DRIVE MOTOR circuit breaker. Install barrels.			
c. Engage TURRET DRIVE MOTOR circuit breaker.			
d. On pilot control panel set MASTER ARM switch to STBY and WPN CONTR switch to GUNNER.			
e. Verify that RANGE switch on gunner control panel is set to SHORT.			
f. On TOW control panel set MODE SELECT switch to TSU/GUN.			
g. On sight hand control set STOW/TRK/ACQ switch to TRK.			
h. Position TSU LOS to 0° az, 0° el.			

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
NOTE The TSU LOS must be maintained at a steady 0° az, 0° el position. This can be better accomplished by placing HI/LO MAG switch to HI and sighting on a distant target. **WARNING** Personnel in cockpit will be extremely careful with turret controls and will make certain power is removed from turret drive motors when personnel on ground are making observations on gunner quadrant. i. Depress and hold left-hand grip action switch. j. With turret held at a steady 0° az, 0° el position, install gunner quadrant on gun barrel. Do not release left-hand grip action switch until directed to do so.	i. Turret will align with TSU LOS.		

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
WARNING Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant. k. Use this steady position to find 0 on gunner quadrant.			
WARNING Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant. l. M On A/C armament circuit breaker panel set FCC/OFF switch to FCC. m. On pilot armament control panel set MASTER ARM switch to ARM.	m. Turret elevation shall increase approximately 9 mils as read on gunner quadrant.	m. Turret elevation does not change or slews to an incorrect position.	m-1. Faulty range enable relay (19K102). Connect test set to system and check range signal by entering 14 on test set keyboard. Refer to table 3-8 DVM address 14 for range signal voltages. m-2. Check range enable aircraft wiring in TM 55-1520-236/239-23. m-3. Check RANGE select switch 19S8 by performing checkout of gunner control panel per paragraph 3-16.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
m. Cont. **WARNING** Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant.			m-4. Check range select aircraft wiring in TM 55-1520-236-23. m-5. M Check fire control computer per TM 55-1520-236/239-23.
n. Set MASTER ARM switch to STBY. **WARNING** Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant.	n. Turret returns to 0 as read on gunner quadrant.		
o. On gunner control panel set RANGE switch to MED and on pilot control panel set MASTER ARM switch to ARM.	o. Turret elevation shall increase to approx. 25 mils as read on gunner quadrant.	o. Turret elevation does not change or slews to an incorrect position.	o-1. Perform checkout of IFCU per paragraph 3-15. o-2. Check RANGE select switch 19S8 on gunner control panel by performinig checkout of gunner control panel per paragraph 3-16. o-2a. M Check logic relay assembly. o-2b. M Check turret buffer amplifier. o-3. Check range select and range enable associated aircraft wiring in TM 55-1520-236/239-23.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
WARNING Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant.			
p. Set MASTER ARM switch to STBY.	p. Turret returns to 0 as read on gunner quadrant.		
WARNING Disengage TURRET DRIVE MOTOR circuit breaker while making observation on gunner quadrant.			
q. On gunner control panel set RANGE switch to LONG and on the pilot control panel set MASTER ARM switch to ARM.	q. Turret elevation shall increase to approx. 43 mils as read on gunner quadrant.	q. Turret elevation does not change or slews to an incorrect position.	q-1. Perform checkout of IFCU per paragraph 3-15. q-2. Check RANGE select switch 19S8 by performing checkout of gunner control panel per paragraph 3-16. q-3. Connect test set to system and check maximum range signal by entering 14 on test set keyboard. Refer to table 3-8 DVM address 14 for range signal voltages. q-4. **M** Check logic relay assembly. q.-5. **M** Check turret buffer amplifier.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
r. Disengage TURRET DRIVE MOTOR circuit breaker and remove gunner quadrant. s. Depress TURRET DRIVE MOTOR circuit breaker. t. On pilot control panel set MASTER ARM switch to STBY and on the gunner control panel set RANGE switch to SHORT. u. Release LHG action switch. v. M On AC armament circuit breaker panel set FCC/OFF switch to OFF. w. Connect airspeed simulator, P/N 11691520, to ADS pitot probe M, to pitot tube E, and simulate 100 knots forward airspeed. M (Position ADS probe to straight ahead). x. With TSU left-hand grip action switch depressed, rotate TSU LOS to right approximately 90°. **WARNING** Observer shall remain outside of barrier zone when performing following step. y. Outside observer shall direct gunner to position TSU LOS such that pointer on turret upper support aligns with OUT line of decal on turret lower support. **WARNING** Observer shall remain outside of barrier zone when performing following step.	t. Turret returns to 0° az, 0° el.		

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
z. **E** While maintaining TSU LOS at above position, set A/S COMPEN switch on gunner control panel to COMPEN. **M** While maintaining TSU LOS at above position, set FCC/OFF switch on A/C armament circuit breaker panel to FCC.	z. Turret shall move further aft until pointer aligns with IN line of decal.	z. Turret does not move at all.	z-1 **E** Check A/S COMPEN switch 19S6 by performing checkout of gunner control panel per paragraph 3-16. **M** Check fire control computer per TM 55-1520-236/239-23. z-2. **E** Connect test set and check Vh unscaled signal (keyboard entry 12). Signal should be approx + 5 (Vac). Enter 68 on keyboard to read compensation signal. If zero is displayed on test set check aircraft wiring for compensation signal. Refer to TM 55-1520-236/239-23 for wiring diagram. z-3. **E** With test set connected to system, check ±18 Vdc output from IFCU to aircraft buffer amplifier A6 by entering 49 and 50 on test set keyboard. If the ±18 Vdc is absent, check IFCU per paragraph 3-15. If ±18 Vdc is present, check airspeed buffer amplifier A6, pressure transducer A12, and aircraft wiring for airspeed compensation per TM 55-1520-236-23. z-4. Check plumbing to airspeed transducer A12 **E** , to ADS probe **M** . Check ADS system per TM 9-1270-219-13&P **M** z-5. **M** Check logic relay assembly.
aa. Release left-hand grip action switch.			
ab. Set FCC/OFF switch to OFF.			

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION Do not apply hydraulic power to system unless electrical power is applied. ac. Connect hydraulic cart, NSN 4933-00-933-4742, to receptacle PC-1. Adjust cart for 1500 ±50 psig. ad. On AC and armament circuit breaker panel disengage TURRET drive circuit breaker. ae. Connect rounds fire simulator P/N 11830648 (part of test set) to turret weapon fire volts connector W2P3. af. Engage TURRET drive circuit breaker. ag. On pilot control panel set RECOIL COMPEN switch to ON. ah. On SCAS control panel set POWER switch to ON. Set YAW, PITCH and ROLL switches ON. ai. On pilot control panel set WPN CONTR switch to GUNNER and MASTER ARM switch to ARM. aj. On sight hand control set STOW/TRK/ACQ switch to TRK. ak. On left-hand grip depress action switch and position TSU LOS to 90° left, 0° el.	ak. Turret moves to 90° left, 0° el position.		

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 5	TSU Compensation Check – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
al. With rotor positioned fore and aft, depress left-hand grip trigger while observing tail rotor and swashplate.	al. Tail rotor response shall be the same as for left pedal inputs. Swashplate inputs shall be the same as for right cyclic stick.	al. No tail rotor or swashplate responses.	al. Perform system checkout per table 3-6 test condition column, substeps 42 thru 47. This verifies presence of torque command and SCAS pitch, roll, and yaw correction voltages. The pitch, roll, and yaw DVM codes on test set are 07, 08, and 09, respectively. (Refer to table 3-8 for description of these DVM codes.) If correct pitch, roll, and yaw voltages are measured, malfunction is in SCAS subsystem. See TM 11-1520-236/239-23 for troubleshooting the SCAS subsystem.
am. Release trigger.			
an. Rotate TSU LOS to 0° az, 0° el.	an. Turret moves to 0° az, 0° el.		
ao. With rotor positioned perpendicular to aircraft, depress left-hand grip trigger while observing swashplate.	ao. Swashplate inputs shall be the same as for aft cyclic stick.		
ap. Release action and trigger switches.			
aq. Set MASTER ARM switch on pilot control panel to OFF.			
ar. Disengage TURRET Drive circuit breaker.			
as. Disconnect rounds fire simulator from W2P3.			
at. Shut down hydraulic cart and disconnect from receptacle PC-1.			
au. Engage TURRET Drive circuit breaker.			

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 6	Pilot Override Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
WARNING Verify that M197 gun, M89E1 feeder, and feed system are clear of live ammunition. a. On gunner control panel set PLT ORIDE switch to PLT ORIDE and NVG switch on gunner cyclic stick to NORM.	a-1. ARM indicators on pilot and gunner control panels are illuminated. a-2. Turret positions to 0° az, approx 11° el.	a-1. ARM indicators not illuminated.	a-1. Check pilot override relay 19K80. Refer to TM 55-1520-236/239-23. a.2 **M** Check logic relay assembly.
b. Depress gunner cyclic stick action switch. Move gunner helmet sight while observing turret.	b. Turret follows GHS movements.	b. Turret does not follow GHS.	b-1. Faulty GHS. Check out HSS per TM 9-1270-212-14&P. b-2. Check out IFCU per paragraph 3-15. **M** Check logic relay assembly. b-3. If b-1 and b-2 are ok, check aircraft wiring in TM 55-1520-236/239-23.
WARNING Verify that M197 gun, M89E1 feeder, and feed system are clear of live ammunition. c. Depress gunner cyclic action and trigger switches.	c. Gun rotates.	c. Gun does not rotate.	c. Faulty trigger signal. Connect test set to system and enter 35 on keyboard. If test set displays 0 Vdc, check aircraft wiring and gunner trigger switch per TM 55-1520-236/239-23. c-1. **M** Check logic relay assembly.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 6	Pilot Override Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
d. Release gunner cyclic stick action and trigger switches. Depress pilot cyclic stick action and trigger switches.	d. Gun will not rotate to pilot trigger command.	d. Gun does rotate.	d. Faulty aircraft trigger interlock circuits. Check circuits per TM 55-1520-236/239-23. d-1. **M** Check logic relay assembly.
e. Release pilot cyclic stick action and trigger switches. Depress left-hand grip action and trigger switches.	e. Gun will not rotate to left-hand grip trigger command.	e. Gun does rotate.	e. Check aircraft wiring per TM 55-1520-236/239-23. **M** Check logic relay assembly.
f. Release left-hand grip action and trigger switches.			
g. On pilot control panel cycle WPN CONTR switch between GUNNER, FIXED, and PILOT positions while observing turret.	g. Turret does not respond to any WPN CONTR switch positions.	g. Turret responds to WPN CONTR commands.	g. Faulty pilot override interlocks. Check aircraft relay 19K80 and interlock relays per TM 55-1520-236/239-23. g-1. **M** Check logic relay assembly.
h. On gunner control panel set PLT ORIDE switch to OFF.			

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 7	Emergency Stow Operations		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
a. Make sure that TURRET STOW circuit breaker on ac and armament circuit breaker panel is OFF. b. Position TURRET DRIVE MOTOR circuit breaker to OFF. **CAUTION** Support barrels when performing following step to prevent barrels from striking ground. c. Release turret elevation and azimuth drive motor brakes. Manually position turret to right mechanical limit and to maximum depression obtainable with barrels installed. Reapply both brakes. **CAUTION** Do not leave TURRET STOW circuit breaker ON for more than 10 seconds if turret fails to move to final stowed position. Damage to emergency stow control unit may occur. d. While observing turret, position TURRET STOW circuit breaker to ON.	c. Verify that GUN ELEV STOWED indicator on caution panel is not illuminated. d-1. Turret moves up to approximately +11° el, then moves to approximately 0° az.	c. GUN ELEV STOWED indicator is illuminated. d-1. Turret does not move or does not stow at proper position.	c-1. Faulty up el stow switch. Visually inspect for stuck or damaged actuator. c-2. Check aircraft wiring in TM 55-1520-236/239-23 for shorts in stowed signal wiring to a 28 Vdc source. d-1a. Check turret stow switch operation per TM 9-1090-206-30. d-1b. Check emergency stow control per paragraph 3-11.

Table 3-5. System Functional Checkout — No Test Equipment — Continued

Step 7	Emergency Stow Operations — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
d. - cont.	d-2. The GUN ELEV STOWED indicator illuminates.	d-2. TURRET STOW indicator not illuminated.	d-1c. Check turret wiring per figure 3-1. d-2a. Faulty stow indicator. Check bulb/caution panel. d-2b. Faulty aircraft wiring. Check per TM 55-1520-236/239-23.
e. Position TURRET STOW circuit breaker to OFF.			
CAUTION Support barrels when performing following step to prevent barrels from striking ground.			
f. Release elevation and azimuth drive motor brakes. Manually position turret to left mechanical limits and to maximum depression obtainable. Reapply both brakes.			
g. Position TURRET STOW circuit breaker to ON while observing turret.	g-1. Turret moves up to approximately +11° el, then moves to approximately 0° az.	g-1. Turret does not move or does not stow at proper position.	g-1a. Check turret stow switch operation per TM 9-1090-206-30. g-1b. Check emergency stow control per paragraph 3-11. g-1c. Check turret wiring per figure 3-1.
	g-2. The GUN ELEV STOWED indicator illuminates.	g-2. TURRET STOW indicator not illuminated.	g-2a. Faulty stow indicator. Check bulb/caution panel. g-2b. Faulty aircraft wiring. Check per TM 55-1520-236/239-23.
h. Place all switches and circuit breakers to off or normal positions.			

Table 3-6. System Functional Checkout — With Test Equipment

Step A0	Test Set Connections, Power Distribution, and Demod Checks		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
1. Perform aircraft armament setup conditions in table 3-4. 2. Position TURRET DRIVE MOTOR circuit breaker to OFF. 3. Connect test set cables W6 and W1 between test set and turret.	2. Deleted.		**M CAUTION** When procedures indicate that a logic relay assembly should be checked; a known good unit must be substituted for the suspected unit and test rerun to verify unit is faulty. When it is indicated that the turret buffer amplifier should be checked, a known good unit or a bypass cable which eliminates the unit from the system should be substituted and test rerun. Bypass cable should not be used when Fire Control Computer is in operation.
4. On test set position AC and DC POWER switches to ON.	4-a. AC and DC POWER indicators are illuminated.	4-a. Test set POWER indicators not illuminated.	4-a. Check aircraft TURRET PWR (19CB4) and WPN CONTR (19CB1) circuit breakers, and W1 power cable to test set.
	4-b. 8888 appears in REFERENCE display, and 88 appears in CODE display of the test set.	4-b. Not all 8's in REFERENCE display and in CODE display.	4-b. Press test set LAMP TEST key to verify all display filament integrity. If all 8's are not displayed, send test set to next higher maintenance level for corrective action.
	4-c. PASS indicator illuminated on test set.	4-c. Possible fault code indications in REFERENCE DISPLAY are: 4-c(1). 9901 through 9909	4-c(1). Test set faulty; send to next higher maintenance level for corrective action.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A0	Test Set Connections, Power Distribution, and Demod Checks – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
4. Cont.		4-c(1.1). 7701 through 7708 indicates read only memory, (A2), failure. 4-c(1.2). 7709 indicates read only memory, (A1), failure. 4-c(2). 9920 indicates central processor unit failure.	4-c(1.1). Test set faulty; send to next higher maintenance level for corrective action. 4-c(1.2). Test set faulty; send to next higher maintenance level for corrective action. 4-c(2). Test set faulty; send to next higher maintenance level for corrective action.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A0	Test Set Connections, Power Distribution, and Demod Checks — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
4. Cont.		4-c(3). 9930 indicates random access memory failure. 4-c(3.1). 9991 indicates improper cable or no cable connected. 4-c(4). 7777 indicates program boards of test set interchanged. 4-c(5). 9994 indicates short interruption malfunction. 4-c(6). FAIL indicator illuminated.	4-c(3). Test set faulty; send to next higher maintenance level for corrective action. 4-c(3.1). Check test set cables W6 and W1 for proper installation. 4-c(4). Test set faulty; send to next higher maintenance level for corrective action. 4-c(5). Test set faulty; send to next higher maintenance level for corrective action. 4-c(6). Send test set to next higher maintenance level for repair.
CAUTION Support barrels when performing following step to prevent barrels from striking ground.			
5. Manually position turret to 30° ± 10° right az and 15° ±10° down el. Reset brake levers.			
6. Depress RUN key on test set.	6. REFERENCE display indicates 1000 and CODE display indicates 88.	6. REFERENCE display does not indicate 1000.	6. Check W6 cable P1 pins S, T, U, V, and W for continuity. Pins S and W should be the only connection. Send W6 cable to next higher maintenance level for repair. If W6 cable ok, send test set to next higher maintenance level.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A0	Test Set Connections, Power Distribution, and Demod Checks — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
NOTE Actions in Step 8 must be completed within 15 seconds after RUN pushbutton is depressed.			
7. Depress A, O, and RUN pushbuttons on test set in that sequence.	7. AO is displayed in CODE display.	7. Other indication or no indication in CODE display.	7. Replace test set if re-entering AO from keyboard does not result in CODE display indicating AO.
8. On pilot control panel set MASTER ARM switch to STBY.	8. Test set PASS indicator illuminated in approximately 5 seconds after STBY is selected.	8. FAIL indicator illuminated.	8-a. Reinitiate AO test by momentarily depressing RUN key. 8-b. Record four digit code (fault code) in REFERENCE display. Depress NEXT LINE key, record new 4-digit fault code in REFERENCE display. Continue until all fault codes have been recorded. Perform corrective action as defined in fault code table 3-7.
9. Repeat test AO by simply pressing RUN key again.	9. Previously illuminated PASS or FAIL indicator is temporarily extinguished when RUN key is depressed.	9. FAIL indicator illuminated.	9. Perform same corrective actions in step 8.
10. On test set depress keys 4 and 8.	10. CODE display contains 48.	10. Any code other than 48 in CODE display.	10. Redepress 4 and 8 keys. Replace test set (faulty keyboard) if 48 does not appear in CODE display. **NOTE** Reinitiation of test set will be required if LAMP TEST pushbutton is depressed. This is accomplished by pressing RUN and 4 and 8 keys.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A0	Test Set Connections, Power Distribution, and Demod Checks — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
11. On test set momentarily depress RUN key. **CAUTION** Support barrels when performing following step to prevent barrels from striking ground.	11. REFERENCE display indicates +1 to +3.5 (Vdc). This is the elevation servo amplifier demod test point.	11. Out of tolerance indication appears on display.	11. Refer to fault code 1115 in table 3-7 for corrective action.
12. Manually raise turret in elevation until a minimum indication is achieved on REFERENCE display. This elevation position will be the FIXED FWD servoed turret position when turret drive motor power is applied. Reapply elevation brake.	12. A null or minimum voltage is obtainable on test set REFERENCE display as the turret is raised in elevation.	12. A null cannot be obtained.	12. Faulty TCU or elevation resolver misaligned greater than 50 degrees. Test TCU and/or align turret elevation resolver in accordance with TM 9-1090-206-30.
13. Depress test set keys 4, 7, and RUN.	13. REFERENCE display indicates +1 to +3.5 (Vdc). This is the azimuth servo amplifier demod test point.	13. Abnormal indication appears.	13. Refer to fault code 1117 in table 3-7 for corrective action.
14. Manually rotate turret in azimuth until a minimum indication is achieved in the REFERENCE display. This will be the servoed position when the turret drive motor power is applied. Reapply azimuth brake.	14. A null is obtained at approximately 0^{o} az.	14-a. A null cannot be obtained or no voltage can be obtained. 14-b. A null occurs at a position other than 0^{o} az.	14-a. Test TCU per paragraph 3-13. See fault code 1117 in table 3-7. 14-b. Align turret azimuth resolver in accordance with TM 9-1090-206-30.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A1	Fixed Forward Servo Stability Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
NOTE Action in step 16 must be completed within 15 seconds after depressing RUN pushbutton.			
15. Depress A, 1, and RUN pushbuttons on test set.	15. A1 appears in CODE display.	15. A1 does not appear in CODE display.	15. Test set may be faulty. Depress RESET key on test set and reenter A1. If CODE display does not indicate A1, see steps 4, 6, and 7 for normal indications and corrective actions.
CAUTION Be prepared to disengage TURRET DRIVE MOTOR circuit breaker if the turret slews into a limit. This is to prevent damage to the drive motor clutches and gearboxes.			
16. Engage TURRET DRIVE MOTOR circuit breaker.	16. The turret is servoed to the fixed forward position. Test set PASS indicator illuminates.	16-a. The turret aligns to a position other than 0° az, 0° el. 16-b. The turret oscillates.	16-a. Align respective turret resolver per TM 9-1090-206-30. 16-a(1) **M** Check turret buffer amplifier. 16-b(1). Perform approximate tachometer test by ohmmeter check of tachometer at following TCU connector pins.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A1	Fixed Forward Servo Stability Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
16. Cont.			Az Tach – Pins R and P on 19A3P244 El Tach – Pins S and T on 19A3P244 Normal impedance is approximately 300 ohms. 16-b(2). Test TCU per paragraph 3-13. 16-b(3). Faulty antibacklash gears on resolver. Send to next higher level of maintenance for corrective action.
		16-c. The turret is not energized.	16-c. See FAIL corrective actions in 16-d following.
		16-d. Test set FAIL indicator is illuminated. (May take as long as 30 seconds after RUN key is depressed.)	16-d(1). Disengage TURRET DRIVE MOTOR circuit breaker. 16-d(2). Record REFERENCE display indication (fault code). 16-d(3). Depress NEXT LINE key on test set and record new fault code appearing in REFERENCE display. 16-d(4). Continue depressing NEXT LINE key until all fault codes are recorded. 16-d(5). Perform corrective action as required by fault code table 3-7. Correct malfunctions in order of fault code presentation.
17. Set MASTER ARM switch on pilot control panel to OFF.			

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A1	Fixed Forward Servo Stability Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
18. Set switches as follows: Pilot control panel WPN CONTR GUNNER Gunner control panel E A/S COMPEN ON E SLEW RATE SLOW E TURRET DEPR LIMIT ON M TUR SLEW GRD TEST M LASER SAFE/ TURRET DEPR LIMIT ON RANGE LONG TOW control panel MODE SELECT TSU/GUN			

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A2	Gunner Stow Position Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION If the turret slews to a position other than 0° az, +11° el, disengage TURRET DRIVE MOTOR circuit breaker.			
19. On pilot control panel position MASTER ARM switch to ARM.	19-a. ARMED indicators on PCP and GCP illuminated.	19-a. ARMED indicators not illuminated.	19-a(1). Check ARMED indicator bulbs. Perform pilot control panel test per pragraph 3-17. 19-a(2). M Check logic relay assembly. 19-a(3). Check aircraft wiring for arm lamp power per TM 55-1520-236/239-23.
	19-b. Turret slews to upper stow position.	19-b. Turret not in upper stow position.	19-b. Faulty TCU. See FAIL indication in substep 20 below for corrective action.
20. E Depress A, 2, and RUN pushbuttons on test set. M Depress A, 9, and RUN pushbuttons on test set.	20. PASS indicator illuminated on test set.	20. FAIL indicator illuminated on test set.	20. Record all fault codes using NEXT LINE key. Perform corrective action as described in fault code table 3-7.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A3	TSU/Track Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
21. On pilot control panel set MASTER ARM to STBY. Position STOW/TRK/ACQ switch on SHC to TRK.			
22. Using SHC position TSU LOS to approximately 0° az and 0° el. **CAUTION** Turret may slew to a position other than that commanded by the TSU LOS. Should this occur, release LHG action switch.	22. TSU follows SHC commands.	22. TSU does not respond to SHC commands.	22. Refer to TMS maintenance manual TM 9-1425-473-20.
23. Depress and hold LHG action switch on TSU LHG.	23-a. Turret aligns with TSU LOS.	23-a(1). Turret aligns to a position other than TSU LOS.	23-a(1)(a). Perform sight bypass check per paragraph 3-8. 23-a(1)(b). Test IFCU for pitch and roll resolver alignment (TM 9-1090-206-30). 23-a(1)(c). Align TSU resolvers per TMS maintenance manual TM 9-1425-473-20. 23-a(1)(d). M Check logic relay assembly.
		23-a(2). Turret does not move from gunner stow.	23-a(2). See fault code 1255 in table 3-7.
	23-b. E GUNS flag is steady in TSU F0V. M G battle flag is lit in TSU F0V.	23-b. E GUNS flag is in motion in TSU F0V. M G battle is flashing in TSU F0V.	23-b. Perform FAIL indication corrective action in substep 24 below.
24. Depress A, 3, and RUN push-buttons on the test set (with LHG action switch held depressed).	24. PASS indicator illuminated on test set.	24. FAIL indicator in test set illuminated.	24. Record all fault codes using NEXT LINE key of test set. Perform corrective action as described in fault code table 3-7.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A3	TSU/Track Check – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
25. Release LHG action switch.	25. Turret slews to gunner stow position.		

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A4	TSU/Track Turret Depression Limit Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION Gun barrels may strike the ground if a malfunction occurs in the turret depression limit circuits. Outside observer to inform TSU operator of this condition.			
26. Position TSU LOS to 0° az, 0° el. Depress and hold LHG action switch, and slowly rotate TSU LOS downward until: E GUNS flag starts in motion in TSU FOV. M G battle flag starts flashing in TSU FOV.	26-a. Turret aligns with TSU LOS. 26-b. Turret stops tracking TSU LOS at approximately -5° el.	26-b. Turret continues below -5 degrees.	26-b(1). Check that the TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch on GCP is set to ON. 26-b(2). Set turret to approximately -10° el with TSU, disengage TURRET DRIVE MOTOR circuit breaker, and perform substep 28 below.
	26-c. When turret reaches the depression limit position: E GUNS flag is in motion in TSU FOV. M G battle flag is flashing in TSU FOV.	26-c. E GUNS flag is steady in TSU FOV. M G battle flag is lit in TSU FOV.	26-c. See corrective actions 26-b(1) and 26-b(2) above.
27. Disengage TURRET DRIVE MOTOR circuit breaker when: E GUNS flag starts in motion in TSU FOV. M G battle flag starts flashing in TSU FOV.			
28. Depress A, 4, and RUN push-buttons on test set.	28-a. A4 appears in CODE display. 28-b. PASS indicator illuminated.	28-b. FAIL indicator illuminated.	28-b. Record all fault codes using NEXT LINE key. Perform corrective action described in fault code table 3-7.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A4	TSU/Track Turret Depression Limit Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
29. When a PASS indication is achieved for A4 test engage TURRET DRIVE MOTOR circuit breaker.			
30. Release LHG action switch.	30. Turret will return to gunner stow position.		

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A5	TSU/Track Out-of-Coincidence Check (Servos De-energized)		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
31. Disengage TURRET DRIVE MOTOR circuit breaker. Set TURRET DEPR LIMIT [E] LASER SAFE/TURRET DEPR LIMIT [M] switch to OFF on GCP.			
32. Manually position turret to 110° right azimuth and 15° down elevation.			
33. With SHC position TSU LOS to approximately 90° left azimuth and 10° up elevation and hold at that position.			
NOTE Steps 34 and 35 below require two personnel.			
34. Depress and hold LHG action switch.	34. [E] GUNS flag is in motion in TSU FOV. [M] G battle flag is flashing in TSU FOV.		
35. Depress test set A, 5, and RUN pushbuttons.	35. PASS indicator illuminated.	35. FAIL indicator illuminated.	35. Record all fault codes using NEXT LINE key on test set. Perform corrective action as described in fault code table 3-7.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A6	Slow Slew and Forcing Function Checks		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
36. On GCP make certain that: E SLEW RATE is set to SLOW. M TUR SLEW is set to GRD TEST. 37. Hold TSU LOS at approximately 90° left azimuth and approximately 10° up elevation. 38. Hold LHG action switch depressed. **NOTE** Actions in step 40 must be completed within 15 seconds after depressing RUN pushbutton.			
39. Depress A, 6, and RUN pushbuttons on test set. 40. Engage TURRET DRIVE MOTOR circuit breaker.	39. A6 appears in CODE display. 40-a. Turret will move slowly up and to the left to align with TSU LOS. 40-b. PASS indicator on test set illuminated. (May require up to 45 seconds to illuminate.)	40-a. Any abnormal indication should be detected by FAIL indication. 40-b. FAIL indicator on test set illuminated.	40-b. Record all fault codes by using NEXT LINE pushbutton on test set. Perform applicable corrective action as indicated in fault code table 3-7.
41. Release LHG action switch. Set STOW/TRK/ACQ switch on SHC to STOW. On TCP set MODE SELECT switch to OFF.	41-a. Turret moves to gunner stow position slowly. 41-b. TSU returns to stow position.	41-b. TSU does not return to stow position.	41-b. Refer to TMS maintenance manual TM 9-1425-473-20.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A7	Gun Trigger Application Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
42. Disengage TURRET DRIVE MOTOR and GUN DRIVE circuit breakers. **WARNING** Make sure gun, feeder, and ammunition box are unloaded and no rounds are remaining in the system. Also make sure all wing stores are downloaded and that no ordnance remains on aircraft. Refer to TM 9-1090-207-13&P. All ordnance systems can be fired from the ground by the gunner cyclic stick trigger with the MASTER ARM switch set to OFF if the PLT ORIDE switch is set to PLT ORIDE.			

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A7	Gun Trigger Application Check – Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
CAUTION When performing following step, be sure to position firing simulator clear of any moving portions of weapon. 43. Connect firing simulator P/N 11830648 (part of test set) to turret weapon fire volts connector W2P3. 43.1 Connect cable W2P1 to W3J1. 44. On pilot control panel set WPN CONTR switch to FIXED, and MASTER ARM switch to ARM. 45. Re-engage TURRET DRIVE MOTOR and GUN DRIVE circuit breaker. 46. Depress A, 7, and RUN keys on the test set. **NOTE** Actions in step 47 must be completed within 15 seconds after depressing RUN pushbutton.	45. Turret moves to 0° az, 0° el position. ARMED indicators on GCP and PCP illuminated. PLT IN CONT indicator on GCP illuminates. 46. A7 appears in the CODE display.		

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A7	Gun Trigger Application Check — Continued		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
47. Depress the pilot cyclic grip trigger switch to second detent for 5 to 10 seconds.	47-a. Gun rotates for full duration of trigger application.	47-a. Gun does not rotate.	47-a. Check gun drive shear pins. Check gun drive motor and cable for broken or frayed wiring.
	47-b. Booster rotates, if installed.	47-b. Booster does not rotate.	47-b(1). Check booster cable, ammo load switch (19S17), and aircraft wiring. 47-b(2). Replace booster motor.
	47-c. Feeder solenoid is energized.	47-c. Feeder solenoid does not energize.	47-c(1). Disconnect W2P2 from feeder solenoid and measure 28 Vdc between pins B and E with action and trigger switches depressed. If 28 Vdc is present, replace feeder solenoid. 47-c(2). Check gun control per paragraph 3-12.
	47-d. The RD RMNG indicator on gunner control panel reads less than 250 if booster rotates.	47-d. RD RMNG indicator still reads 250.	47-d(1). Check gunner control panel per paragraph 3-16. 47-d(2). Check aircraft wiring for rounds totalizer and rounds remaining circuits per TM 55-1520-236/239-23.
	47-e. Test set PASS indicator illuminated.	47-e. Test set FAIL indicator illuminated.	47-e. Record all fault codes using NEXT LINE pushbutton on test set. Perform corrective action as defined by corresponding fault code table 3-7.

Table 3-6. System Functional Checkout — With Test Equipment — Continued

Step A8	Gun Trigger Release Check		
Test Condition	**Normal**	**Abnormal**	**Corrective Action**
48. Depress A, and 8 pushbuttons on test set. 49. Depress and hold pilot cyclic stick action and trigger switches. 50. Momentarily depress RUN pushbutton on test set.	48. A8 appears in CODE display.		
51. Release pilot cyclic stick trigger switch.	51. Test set PASS indicator illuminated.	51. Test set FAIL indicator illuminated.	51. Record all fault codes using NEXT LINE pushbutton. Perform corrective action as defined for fault codes in table 3-7.
52. Remove power from test set, and turret system. 52.1. Disconnect cable W2P1 from W3J1. 53. Disconnect rounds fire simulator from W2P3. 54. Disconnect test set.			

Table 3-7. System Checkout Fault Codes

Step	A0	Test Set Connections, Power Distribution, and Demod Checks				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
						M CAUTION When procedures indicate that a logic relay assembly should be checked; a known good unit must be substituted for the suspected unit and test rerun to verify unit is faulty. When it is indicated that the turret buffer amplifier should be checked, a know good unit or a bypass cable which eliminates the unit from the system should be substituted and test rerun. Bypass cable should not be used when Fire Control Computer is in operation.
1000	Cable decoding				W6 cable properly decoded by test set.	None required.
1100	Standby relay coil power	46	+22 to +30 (Vdc)	−1 to +4 (Vdc)	Pilot MASTER ARM switch must be set to STBY within 15 seconds of test set RUN key depression. Check set up and sequence.	Faulty pilot control panel MASTER ARM switch; test PCP per paragraph 3-17. Check aircraft wiring. Refer to TM 55-1520-236/239-23. **M** Check logic relay assembly.
1101	Low level 28 Vdc at GCU	45	+0.9 to +3.0 (Vdc)	0 to +0.8 (Vdc)	Checks out contacts on standby relay and power to GCU.	Troubleshoot power contacts on relay 19K38/B1 per system schematic. Refer to TM 55-1520-236/239-23. **M** Check logic relay assembly.

Table 3-7. System Checkout Fault Codes — Continued

Step	A0	Test Set Connections, Power Distribution, and Demod Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1102	Master arm relay coil power	43	−1 to +4 (Vdc)	+20 to +30 (Vdc)	System should be in standby mode only.	Check position of pilot MASTER ARM switch for STBY; if ok, test PCP per paragraph 3-17. If PCP ok, check that GCP PLT ORIDE switch is set to OFF. Test GCP per paragraph 3-16; if ok, troubleshoot aircraft wiring per system schematic. **M** Check logic relay assembly.
1103	Fixed forward signal	72	+20 to +30 (Vdc)	0	Checks out the WPN CONTR switch on the pilot control panel.	Test PCP per paragraph 3-17. If ok, check aircraft wiring per system schematic in TM 55-1520-236/239-23. **M** Check logic relay assembly.
1104	GCU 115 Vac test point	22	+100 to +125 (Vac)	0	Checks the 115 Vac, 400 Hz through the aircraft standby relay 19K38 to the GCU.	Check GCU filter on J1 by GCU test. If ok, troubleshoot aircraft wiring per system schematic. **M** Check logic relay assembly.
1105	26 Vac reference in GCU	51	+23 to +29 (Vac)	0	Failure of reference transformer in GCU if fault code 1104 did not appear.	Test GCU. Check for shorts on 26 Vac output of GCU.
1106	10 Vac reference in GCU	06	+8 to +12 (Vac)	0	Failure of 10 Vac reference in GCU. This is used as resolver excitation.	Test GCU. Check for shorts on 10 Vac output of GCU.
1107	Burst limit test point	02	+10 to +14 (Vdc)	0	Used to verify ±12 Vdc of GCU is functional.	Check for invalid burst limit input signal (DVM 33). If 0 appears on DVM, test GCU. **M** Check logic relay assembly.

Table 3-7. System Checkout Fault Codes — Continued

Step	A0	Test Set Connections, Power Distribution, and Demod Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1108	Regulated 28 Vdc from GCU	29	+24 to +27 (Vdc)	0	Used to check out regulated 28 Vdc for resolver buffers in turret and IFCU, and emergency stow relay power.	Test GCU. If faulty, check for shorts on regulated 28 Vdc output of GCU.
1111	+15 Vdc power supply in LCU	05	+13 to +17 (Vdc)	0		Go to DVM code 21 and verify that −26 Vac appears; if not test LCU. If ok check 115 Vac input power to LCU.
1112	−15 Vdc power supply in LCU	04	−13 to −17 (Vdc)	0		Test LCU. If ok check 115 Vac input power to LCU.
1113	+5 Vdc power supply in LCU	03	+4 to +6 (Vdc)	0	Used only by the torque command circuit for SCAS.	Test LCU. If ok check aircraft wiring for 28 Vdc at input to LCU.
1114	Pitch (SCAS) correction voltage	07	+0.3 to +1.4 (Vac)	Variable dependent on turret position	This signal will vary according to turret azimuth and elevation position. This signal is available whether in standby or arm mode. It is dependent upon turret resolver functionality. See fault code 1115.	Perform LCU test. If ok check applicable aircraft wiring (TM 55-1520-236/239-23) and turret resolver operation and alignment (TM 9-1090-206-30).
1115	Elevation demodulator failure	48	+1 to +3.5 (Vdc)	Variable see comments	Under A0 setup conditions, this signal is positive in phase. However, this signal will vary between + and − dc when the turret is manually positioned around the 0° elevation position. The test is also used to check the ±15 Vdc power supply of the TCU and the demods for proper operation.	Test TCU per paragraph 3-13. If ok, check resolver alignment (TM 9-1090-206-30). **M** Check turret buffer amplifier.
1116	Yaw signal SCAS correction	09	+1.6 to +3.4 (Vac)	Variable dependent on turret position	This signal is a function of the turret azimuth position. Under A0 setup conditions, the right side results in a − sign which signifies a negative phase. The weapon select switch on the LCU unit, when set to 30-mm,	Test LCU to verify its operation. If ok failure is in azimuth resolver or its alignment. Perform turret azimuth resolver alignment. Refer to TM 9-1090-206-30.

Table 3-7. System Checkout Fault Codes — Continued

Step	A0	Test Set Connections, Power Distribution, and Demod Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1116 - cont.					should increase the voltage by approximately 50%. (The 30-mm position is not presently being used.) The purpose of this measurement is to check the turret azimuth resolver coarse alignment.	
1117	TCU azimuth demodulator	47	+1.0 to +3.5 (Vdc)	Variable dependent upon turret position	This check is to verify that the azimuth error signal is functioning properly in the TCU.	If manual movement of turret azimuth does not change DVM reading, test TCU per paragraph 3-13. If ok, fault isolate turret resolver buffer amplifier. Refer to TM 9-1090-206-30. **M** Check turret buffer amplifier.
1118	AZ 1.5° detector in LCU.	63	+4 to −1 (Vdc)	+28 (Vdc)	Since the turret is not at 0° az this detector will indicate out of coincidence. The input signal for this circuit is the TCU az demod. When az demod is nulled (less than 0.3 Vdc) the az 1.5° detector output is 28 Vdc.	Test LCU per paragraph 3-14 if az demod is greater than ±0.5 Vdc and the az 1.5° detector is still 28 Vdc. If LCU test indicates PASS, check az demod circuit to LCU. Refer to TM 55-1520-236/239-23.
1121	Gunner stow interruption in LCU	60	+2 to −1 (Vdc)		This signal is generated primarily by an out-of-coincident condition of 4.5° or more in elevation and by the turret in depression limit. Also, ±15 Vdc interlock or 28 Vdc HL circuit malfunctions in TCU can cause this signal to be generated.	Test TCU (paragraph 3-13). If TCU is ok, test LCU (paragraph 3-14). If LCU is ok, check out aircraft wiring to circuits described in comments columns.
1122	90° out-of-coincidence in LCU	61	−1 to +1 (Vdc)	+1.7 (Vdc)	This test point is in parallel with the LED on LCU. Moving the turret beyond 90° in azimuth manually while in the FIXED mode will cause the LED to be illuminated. This is caused by the turret azimuth resolver cosine output changing phase.	Test LCU (paragraph 3-14); if ok perform azimuth resolver alignment per TM 9-1090-206-30.

Table 3-7. System Checkout Fault Codes — Continued

Step	A0	Test Set Connections, Power Distribution, and Demod Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1123	Azimuth interrupt to GCU	18	+4 to −1 (Vdc)	+10 to +28 (Vdc)	This signal under A0 setup conditions should be as specified. When turret is properly servoed, the normal indication is approximately +15 Vdc to the GCU from the LCU.	Perform fault isolation by DVM monitoring of the following signals. A. Azimuth resolver (DVM 09) B. Gunner stow (DVM 60) C. Azimuth demod (DVM 47) D. Azimuth 1.5° (DVM 63) E. Depression limit (DVM 01) F. Out of coincidence (DVM 61)
1124	Elevation interrupt to GCU	40	+4 to −1 (Vdc)	+10 to +28 (Vdc)	See fault code 1123 for description.	Perform LCU test (paragraph 3-14) if elevation demodulator signal (DVM 48) is ok. If LCU tests ok perform GCU test (paragraph 3-12). Check appropriate wiring in aircraft. Refer to TM 55-1520-236/239-23.
1131	Emergency stow relay return	58	+20 to +30 (Vdc)	+3.7 (Vdc)	When this signal is low it signifies that the regulated 28 Vdc is ok, the ±15 Vdc of the TCU is ok, and HL 28 Vdc is within its limits. If 0 Vdc appears, the stow relay coil or its wiring is open, or the regulated 28 Vdc is faulty. When this signal is high it signifies that the low voltage cutout circuit is faulty in the TCU, or that the aircraft wiring between the turret and turret control J3-N is open.	Perform test sequence A1 (servo's energized) to see if this makes this test point change state. Exercise caution as inadvertent slewing of the turret may result. Check for shorts on this function, using aircraft and turret schematics. Perform TCU test per paragraph 3-13.

Table 3-7. System Checkout Fault Codes — Continued

Step	A0	Test Set Connections, Power Distribution, and Demod Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1132	Up limit	39	+20 to +30 (Vdc)	0	All these limits are "forced" high by the pilot (FIXED FWD) signal in the TCU regardless of turret limit switch status.	Test TCU per paragraph 3-13. If ok, check FIXED FWD signal (DVM address 72). Check for shorts on respective limit switch wiring.
1133	Dn limit	38	+20 to +30 (Vdc)	0		
1141	Rt limit	37	+20 to +30 (Vdc)	0		
1142	Lt limit	36	+20 to +30 (Vdc)	0		
1143	Limit switch power source	41	+20 to +30 (Vdc)	0	28 Vdc from GCU goes through TCU to limit switches in turret.	Test TCU per paragraph 3-13. Check for shorts in limit switches. See aircraft and turret schematics for detailed wiring.
1144	+18 Vdc in IFCU	50	+16 to +20 (Vdc)	0	Prior to replacing a faulty IFCU, check for shorts on this signal.	Test IFCU per paragraph 3-15. If ok, check input power to IFCU as follows: DVM 24 = 115 Vac DVM 46 = +28 Vdc Refer to aircraft wiring in TM 55-1520-236/239-23.
1145	−18 Vdc in IFCU	49	−16 to −20 (Vdc)	0	See fault code 1144 for description. The only difference is that this is a negative power supply instead of the positive power supply.	See fault code 1144 above.

Table 3-7. System Checkout Fault Codes — Continued

Step	A1	Fixed Forward Servo Stability Check				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1150	Turret drive motor power relay control	28	+20 to +30 (Vdc)	0	The GCU regulated 28 Vdc supply turn on starts a 3-second delay for HL 28 Vdc control. This delays aircraft relay energization until resolver buffers have stabilized.	Was TURRET DRIVE MOTOR circuit breaker pushed in within 30 seconds of test set RUN key? If yes, check GCU (paragraph 3-12); if GCU ok, check aircraft relay and overload sensor (19K7 and 19S18) per system schematic in TM 55-1520-236/239-23.
1151	Emergency stow relay return	58	+2.1 to +5.9 (Vdc)	+28 (Vdc)	Refer to fault code 1131.	Refer to fault code 1131.
1152	Azimuth demod	48	−1.1 to +1.1 (Vdc)	Variable	Turret should be servoed and a null should be obtained.	Test TCU (paragraph 3-13). If TCU ok, turret drive motor failure is likely cause of fault. **M** Check turret buffer amplifier.
1153	Elevation demod	47	−1 to +1 (Vdc)	Variable	See fault code 1152 for comments.	See fault code 1152.
1154	Gunner stow interrupt	60	+2.1 to +4.0 (Vdc)	0	Since the turret is servoed to 0° az, 0° el and pilot (FIXED FWD) signal is applied to TCU, the failure should not occur in the TCU.	Test LCU for depression limit failure (paragraph 3-14).
1155	Elevation error interlock at GCU	40	+10 to +20 (Vdc)	0	This fault code indicates the 1.5° error detector of the LCU is faulty. Resolve problem relating to elevation demod prior to checkout of this fault code.	Test LCU (paragraph 3-14). If LCU ok, test GCU (paragraph 3-12). If both LCU and GCU pass, check aircraft wiring for the elevation interlock signal from LCU to GCU. Refer to TM 55-1520-236/239-23.
1156	Pitch correction (SCAS) signal	07	+1.5 to +4.0 (Vac)	Variable	This check is used to verify that the turret azimuth resolver cosine signal is correct.	Test LCU per paragraph 3-14; if ok, perform turret resolver alignment. Refer to TM 9-1090-206-30.

Table 3-7. System Checkout Fault Codes — Continued

Step	A1	Fixed Forward Servo Stability Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1156 cont.					Two failures could cause this fault code to occur: (1) Turret resolver alignment or failure. (2) Logic control failure.	
1157	Azimuth 1.5° detector	63	+10 to +20 (Vdc)	0	The voltage at this point is a direct result of the az demod signal amplitude. Demod signal (DVM = 47) at this time should be less than 0.2 Vdc. If not, correct the demod malfunction first.	Test LCU per paragraph 3-14.
1161	Azimuth error in-lock to GCU.	18	+10 to +20 (Vdc)	0	This signal is a result of many interlocks, any one of which can cause this signal to fail.	Perform LCU test per paragraph 3-14. If LCU is OK, test GCU per paragraph 3-12.
1162	Reticle flasher test point at GCU.	75	+4 to −1 (Vdc)	Pulsing		Perform GCU test (paragraph 3-12) if all interruption signals are within specified readings. See DVM 62 in table 3-8.
Step	A2	**Gunner Stow Position Check**				
1181	Standby relay coil power	46	+20 to +30 (Vdc)	0	Refer to fault code 1100.	
1182	28 Vdc at GCU	45	2.1 to 4.0 (Vdc)	0	Refer to fault code 1101.	
1183	IFCU 28 V PWR ON signal	44	+20 to +30 (Vdc)	0	This is a signal from the standby relay contacts.	Check standby relay 19K38 contacts and aircraft wiring. Refer to TM 55-1520-236/239-23.
1184	HL turret drive motor control voltage	28	+20 to +30 (Vdc)	0	Refer to fault code 1150.	**M** Check logic relay assembly.
1185	115 Vac at GCU	22	+100 to +125 (Vac)	0	Refer to fault code 1104.	

Table 3-7. System Checkout Fault Codes — Continued

Step	A2	Gunner STow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1186	28 Vac at GCU	51	+20 to +29 (Vac)	0	Refer to fault code 1105.	
1187	10 Vac at GCU	06	+8 to +12 (Vac)	0	Refer to fault code 1106.	
1188	Burst limit output GCU test	02	+4 to +14 (Vdc)	0	Refer to fault code 1107.	
1191	Regulated 28 Vdc from GCU	29	+24 to +27 (Vdc)	0	Refer to fault code 1108.	
1192	+15 Vdc power supply in LCU	05	+13 to +17 (Vdc)	0	Refer to fault code 1111.	
1193	-15 Vdc power supply in LCU	04	-13 to -17 (Vdc)	0	Refer to fault code 1112.	
1194	+5 Vdc power supply in LCU	03	+4 to +6 (Vdc)	0	Refer to fault code 1113.	
1195	Emergency stow relay return	58	+2.1 to +5.9 (Vdc)	See comments	This relay (K1 in ESU) should have regulated 28 Vdc on terminal X1 from GCU. The TCU should provide a ground through a 39-ohm resistor for the relay X2 terminal if the TCU has functional ±15 Vdc power supplies and HL 28 Vdc.	Test TCU per paragraph 3-13, if ok test GCU per paragraph 3-12. If DVM 58 reading is 0 Vdc, check relay K1 continuity in ESU and its respective wiring per system and turret schematic.
1196	Pitch correction (SCAS) test point of LCU	07	+2.5 to +4 (Vac)	Variable	This signal is a composite of the azimuth and elevation turret resolver outputs generated in the LCU. The null for this signal should occur when turret position is about −20° el and 0° az.	Test LCU per paragraph 3-14. If ok, check turret resolver operation by performing resolver alignment per TM 9-1090-206-30.

Table 3-7. System Checkout Fault Codes — Continued

Step	A2	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1197	Elevation demod TCU	48	−1 to +1 (Vdc)	Variable between ±3 (Vdc)	This should be a null as the turret is servoed.	Test TCU per paragraph 3-13 if turret does not synchronize to 0° az, 0° el. If TCU checks ok, check resolver alignment (TM 9-1090-206-30). **M** Check turret buffer amplifier.
1198	Yaw correction (SCAS) test point of LCU	09	+1 to −1 (Vdc)	±6 (Vac)	This is a signal generated by the turret azimuth resolver Sine output appropriately scaled by the LCU.	Test the LCU per paragraph 3-14. If ok, perform resolver alignment per TM 9-1090-206-30.
1201	Azimuth demod of TCU	47	+1 to −1 (Vdc)	±3 (Vac)	This should be a null if the turret is servoed in azimuth. Refer to fault code 1117.	Test TCU per paragraph 3-13. If ok, check resolver alignment per TM 9-1090-206-30. **M** Check turret buffer amplifier.
1202	Azimuth 1.5° detector in LCU	63	+20 to +30 (Vdc)	0	This should be +28 Vdc because the turret is servoed to the 0 degree azimuth position. Refer to fault code 1118.	Perform LCU test per paragraph 3-14.
1203	Gunner stow interrupt	60	+1 to −1 (Vdc)	+2.1 (Vdc) or higher	Lack of action or fixed forward signal to TCU causes this to be a low voltage because relay A8K1 is de-energized without either of these signals.	Measure fixed forward signal by entering DVM 72 on test set. Indication should be 0 (Vdc). If not, test TCU per paragraph 3-13.
1204	90° out-of-coincidence in LCU	61	+1 to −1 (Vdc)	Greater than ±1.6 (Vdc)	This test point is parallel to the LED on the front of the LCU. Visual inspection of LED indicates a condition where the turret azimuth resolver is out of alignment, or the turret resolver is malfunctioning.	If fault code 1196 did not occur, perform LCU test per paragraph 3-14.
1205	Turret limit switch power	41	+20 to +30 (Vdc)	0	See fault code 1143.	

Table 3-7. System Checkout Fault Codes — Continued

Step	A2	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
					NOTE The following general comments are applicable to fault codes 1206, 1207, 1208, and 1211. 1. Turret must not be any limit 2. Fault code 1205 must be corrected first (if applicable). 3. Check for shorts on limit switch wiring. 4. Prior to replacing switch assembly check for shorts on applicable switch outputs.	Checkout for proper operation may be accomplished by removing turret drive motor power and emergency stow power and manually positioning turret into its respective limits while monitoring that limit switch test point. Adjust limit switch actuators per procedures found in TM 9-1090-206-30.
1206	Right limit switch output	37	+16 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace azimuth switch assembly.
1207	Left limit switch output	36	+16 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace azimuth switch assembly.
1208	Up limit switch output	39	+16 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Check for sticking "dog leg" linkage. Replace elevation switch assembly.
1211	Down limit switch output	38	+16 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace elevation switch assembly.
1212	+18 Vdc in IFCU	50	+16 to +20 (Vdc)	0	Check for shorts on IFCU +18 Vdc output to prevent a second IFCU from short circuit failure. A failure in +18 Vdc circuit will cause the GHS and PHS to be non-functional.	Test IFCU per paragraph 3-15. Should IFCU test ok, check aircraft test connector 19J1 wiring. Refer to TM 55-1520-236/239-23.

Table 3-7. System Checkout Fault Codes — Continued

Step	A2	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1213	-18 Vdc in IFCU	49	-16 to -20 (Vdc)	0	Check for shorts on IFCU -18 Vdc output to prevent a second IFCU from short circuit failure. A failure in -18 Vdc circuit will cause GHS and PHS to be non-functional.	Test IFCU per paragraph 3-15. Should IFCU test ok, check aircarft test connector 19J1 wiring. Refer to TM 55-1520-236/239-23.
1231	Depression limit enable signal	73	+20 to +30 (Vdc)	0	The turret depression limit switch provides 28 Vdc to the LCU.	Check test setup conditions in table 3-6 (TURRET DEPR LIMIT **E** LASER SAFE/TURRET DEPR LIMIT **M** switch on GCP to ON). Test GCP per paragraph 3-16. If ok, check applicable aircraft wiring. Refer to TM 55-1520-236/239-23.
1232	Slow slew enable	65	-1 to +4 (Vdc)		The SLOW SLEW **E** TUR SLEW **M** switch provides a ground for the TCU slow slew circuitry.	Check test setup conditions in table 3-6 (on GCP check that: **E** SLEW RATE is set to SLOW **M** TUR SLEW is set to GRD TEST). Test GCP per paragraph 3-16. Test TCU per paragraph 3-13. If these units pass, check aircraft slow slew wiring and ground on pin R of 22A3P1. Refer to TM 55-1520-236/239-23.
1233	Compensation signal from GCP	68	+20 to +30 (Vdc)	0		Test GCP per paragraph 3-16. If ok, check aircraft wiring. Refer to TM 55-1520-236/239-23.
1234	Range drop correction voltage	14	(+1 to -1) (Vac) See comments	(More than) (+1 Vac) See comments	Refer to DVM 14 in table 3-8 for description of system voltage measurements. This signal is generated in the IFCU from the selected sight unit, and is enabled by the master arm signal to the range enable relay 19K102.	Refer to table 3-7, DVM 14. If this fault code appears it indicates a major failure in the IFCU.
1235	Master arm relay coil	43	+20 to +30 (Vdc)	0		Check test setup conditions in table 3-6 (MASTER ARM switch on PCP to ARM). Test PCP per paragraph 3-17. If ok, check applicable aircraft wiring per TM 55-1520-236/239-23. **M** Check logic relay assembly.

Table 3-7. System Checkout Fault Codes — Continued

Step	A3	TSU/Track Check				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1250	Track signal	42	+20 to +30 (Vdc)	0	This signal initiates the monitoring of the remaining A3 signals. This fault code is used to detect whether and when the track switch was closed.	Check test setup in table 3-6. If setup conditions ok, check track switch circuits by GHS operation or PHS operation. (Refer to TM 9-1270-212-14&P.) Check aircraft action disable relay (21K7) per schematic in TM 55-1520-236/239-23. **M** Check logic relay assembly.
1251	TCU action signal	71	+20 to +30 (Vdc)	0	This signal transfers turret control unit position command signal from the gunner stow signals to sight error signal for turret drive motor control.	Check aircraft action interrupt relay 19K88 per schematic in TM 55-1520-236/239-23. **M** Check logic relay assembly.
1252	Sight elevation error	10	+1 to −1 (Vac)	Variable with + and - phase	If the turret is synchronizing to the TSU LOS this signal will be a null at synchronization.	If no error can be observed on DVM 10, TSU or IFCU is faulty. Test IFCU per paragraph 3-15. If IFCU is ok, check system with test set sight simulator per paragraph 3-8. If turret checks ok in paragraph 3-8, then TSU is faulty. Refer to TM 9-1425-473 series manuals. **M** Check turret buffer amplifier.
1253	Depression limit output circuit elevation error signal	11	+1 to −1 (Vac)	± Variable	This signal will track DVM 10 unless a failure in depression limit circuit occurs or depression limit circuit is enabled.	Test LCU per paragraph 3-14. **M** Check turret buffer amplifier.
1254	Elevation demod	48	+1 to −1 (Vac)	Variable	Dependent upon DVM 11 if in the TSU track mode.	Faulty servo system due to TCU failure. Test TCU per paragraph 3-13 if turret fails to respond to TSU commands. **M** Check turret buffer amplifier.
1255	Gunner stow interrupt	60	+2.1 to +4.0 (Vdc)	See corrective action	See fault code 1203 for technical description. This check assumes the TCU output to be ok in this mode. The turret depression interlock is checked to see that it is not inadvertently tripped.	Perform TCU test if DVM reading is 0 (Vdc). Perform depression limit test (A4 in table 3-6) if DVM reading is -3 (Vdc). Check to see if TSU LOS is at 0° az, 0° el and turret is at 0° az, 0° el.

Table 3-7. System Checkout Fault Codes — Continued

Step	A3	TSU/Track Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1256	Selected "Q"	15	+2.5 to +5.0 (Vac)	Variable	This signal is the TSU range reference generated by the turret, IFCU, and TSU resolver chain. This signal is selected in the LCU when the track signal (+26 Vdc) is applied and the TOW signal and the pilot in control signal are off (0 Vdc).	Check input signals to LCU as follows: 1. Track (DVM 42) = +26 Vdc 2. TOW (DVM 76) = 0 Vdc 3. Pilot in control (DVM 59) = 0 Vdc 4. +18 Vdc from IFCU (DVM 50) = +18 Vdc 5. -18 Vdc from IFCU (DVM 49) = -18 Vdc 6. TSU range ref (DVM 13) = +2.5 to +5.0 Vac Test LCU per paragraph 3-14 if inputs are correct.
1257	90° out-of-coincidence signal	61	-1 to +1 (Vdc)	±1.7 (Vdc)	See fault code 1204.	Test LCU per paragraph 3-14 if fault code 1257 did not appear.
1258	Elevation interrupt to GCU	40	+10 to +20 (Vdc)	0	See fault code 1124.	Test LCU per paragraph 3-14 if fault code 1255 did not appear and the turret is servoed to TSU LOS.
1261	Azimuth demod	47	+1 to −1 (Vdc)	±2.5 (Vdc)	Variable voltage here if servo is disabled. Voltages dependent upon angular difference between turret and TSU azimuth angles when all units (turret resolvers, IFCU, TSU, and TCU) are functional.	Test turret resolvers per TM 9-1090-206-30. Test TCU per paragraph 3-13. Test IFCU per paragraph 3-15. **M** Check turret buffer amplifier.
1262	Azimuth interrupt signal	18	+10 to +20 (Vdc)	0	Refer to fault code 1161.	Refer to fault code 1161.
1263	Yaw correction (SCAS) signal	09	+1 to −1 (Vac)	Variable	Refer to fault code 1116.	Refer to fault code 1116.
1264	Pitch correction (SCAS) signal	07	+1.5 to* +3.0 (Vac)	Variable	Refer to fault code 1114.	Refer to fault code 1114.

Table 3-7. System Checkout Fault Codes — Continued

Step	A4	TSU/Track Turret Depression Limit Check				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1281	Pitch correction (SCAS) signal	07	+1.3 to +2.0 (Vac)	Variable	This signal measures the turret elevation angle at which the turret depression limit circuit activates.	Signal should appear when turret is -5° el when TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch on GCP is on. Corrective action is to adjust the turret elevation resolver per TM 9-1090-206-30. Test LCU per paragraph 3-14. Check that weapon select switch on LCU is in 20-mm position.
1282	Depression limit control voltage	01	+10 to +17 (Vdc)	Negative voltage		Check that TURRET DEPR LIMIT E LASER SAFE/TURRET DEPR LIMIT M switch on GCP is on. Test LCU per paragraph 3-14.
1283	Azimuth error interrupt to GCU.	18	-1 to +4 (Vdc)	+10 to +27 (Vdc)	See fault code 1161.	Test LCU per paragraph 3-14. If LCU tests ok, test GCU per paragraph 3-12.
1290	Flasher test point	75	Pulsing dc (0 and +28 Vdc)	Steady 0 or +28 (Vdc)	Activation of depression limit circuit should have caused this signal to pulse. The corrective actions specified will verify functions of circuits which cause reticle flasher operation.	Measure signals listed under DVM 62 in table 3-8 (except DVM 35 trigger) for normal indications. If all inputs are within limits replace GCU.

Table 3-7. System Checkout Fault Codes — Continued

Step A5		TSU/Track Out-of-Coincidence Check (Servos De-energized)				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1300	Track signal	42	+20 to +30 (Vdc)	0	Refer to fault code 1250.	Refer to fault code 1250.
1301	Turret control action	71	+20 to +30 (Vdc)	0	Refer to fault code 1251.	Refer to fault code 1251.
1302	Selected "Q"	15	-5 to +3 (Vac)		TSU and turret not set up as described in procedure for this measurement sequence.	Check set up condition (TSU at 90° left az, and turret at 110° right az). Check action switch on LHG closed. Refer to fault code 1256.
1303	90° out-of-coincidence	61	+0.9 to +2.0 (Vdc)	0	Refer to 1257 fault code.	**M** Check turret buffer amplifier.
1304	Azimuth demod	47	+1 to +4 (Vdc)	Negative voltage	The LCU should be providing a forcing signal into the IFCU which would make the azimuth track error signal generate a left drive command to the azimuth turret drive motor.	Test LCU per paragraph 3-14. Perform LCU test per paragraph 3-14 if fault code 1302 did not appear. **M** Check turret buffer amplifier.
1305	Gunner stow interrupt	60	-1 to +2 (Vdc)	Greater than +5 (Vdc)	See fault code 1121.	See fault code 1121.
1306	Azimuth 1.5° test point LCU	63	-1 to +4 (Vdc)	+10 to +20 (Vdc)	Since the azimuth demod is not nulled, this test point should indicate out-of-coincidence in excess of 1.5° if the LCU is functional.	Test LCU per paragraph 3-14 if fault code 1304 did not appear.
1307	Azimuth interrupt to GCU	18	-1 to +4 (Vdc)	+10 (Vdc) or higher	Multiple signals should cause this signal to be low. These signals are described in fault codes 1303, 1304, 1305 and 1306. The corrective actions for those fault codes must be performed prior to corrective action for this fault code.	See comments column. Test LCU per paragraph 3-14 for malfunction in azimuth interrupt. Perform GCU test per paragraph 3-12.
1308	Elevation interrupt	40	-1 to +4 (Vdc)	+20 to +27 (Vdc)	Since the servos are disabled this interruption should occur.	Check DVM 48 for a voltage greater than 0.5 (Vdc). Test LCU per paragraph 3-14. If LCU ok, test GCU per paragraph 3-12 for elevation error interrupt input circuit malfunction.

Table 3-7. System Checkout Fault Codes — Continued

Step	A6	Slow Slew and Forcing Function Checks				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1320	Turret drive motor power relay control	28	+20 to +30 (Vdc)	0	See fault code 1150.	See fault code 1150.
1321	Slow slew enable signal	65	-1 to +1 (Vdc)	Greater than +5.9 (Vdc)	Must have SLEW RATE E TUR SLEW M switch on GCP set to SLOW E GRD TEST M. See fault code 1232.	Test GCP per paragraph 3-16. If ok, test TCU per paragraph 3-13.
1322	Emergency stow relay return	58	+2.1 to +5.9 (Vdc)	Greater than +10 (Vdc)	Refer to fault code 1131.	Refer to fault code 1131.
1331	Elevation demod	48	+4 to -1.0 (Vdc)	Variable	This is the first test of the TCU response. If this code appears the turret elevation position command would be such that large down drive command existed. This is caused by a malfunction in either the TCU or the direction cosine resolver chain.	Forcing function circuits in LCU are faulty if the system functions normally in the TSU track mode. Test LCU per paragraph 3-14. Check setup conditions (step 37 of table 3-6) relative to the specified angles for TSU and turret.
1341	Elevation demod	48	-1 to +1 (Vdc)		Turret slow slew speed is too slow or angular difference is too great.	See fault code 1331. Also turret may be into up limit.
1351	Azimuth demod	47	+1 to +4 (Vdc)		This is the first measurement of the azimuth demod during slow slew. If this measurement is outside the +1 to +4 Vdc limits, the turret has slewed too fast to its final commanded position.	On GCP check that: SLEW RATE is set to SLOW. TUR SLEW is set to GRD TEST.
1361	Azimuth demod	47	-1 to +1 (Vdc)		This measurement is made 40 seconds after the turret drive motor power was applied.	Slow slew circuits faulty in the TCU. Check TCU per paragraph 3-13.

Table 3-7. System Checkout Fault Codes — Continued

Step	A6	Slow Slew and Forcing Function Checks — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1362	Gunner stow interrupt	60	+2.1 to +4.0 (Vdc)		See fault code 1305.	This fault code requires no corrective action if fault code 1341 appeared and was corrected. Otherwise, see fault code 1121.
1363	Azimuth 1.5° interrupt	63	+10 to +20 (Vdc)	0	See fault code 1306.	This fault code requires no corrective action if fault code 1361 was displayed.
1364	Azimuth interrupt	18	+10 to +20 (Vdc)	0	See DVM 18 in table 3-8 for comments.	See fault code 1307.
1365	Elevation interrupt	40	+10 to +20 (Vdc)	0	See DVM 40 in table 3-8 for comments.	See fault code 1308.

Table 3-7. System Checkout Fault Codes — Continued

Step	A7	Gun Trigger Application Check				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1381	Standby relay coil power	46	+20 to +30 (Vdc)	0	See fault code 1100.	Check setup (system in ARM mode). See fault code 1100. **M** Check logic relay assembly.
1382	Arm relay coil power	43	+20 to +30 (Vdc)	0		Check setup (system in ARM mode). Check aircraft wiring. (Refer to TM 55-1520-236/239-23. **M** Check logic relay assembly.
1383	Fixed Fwd signal	72	+20 to +30 (Vdc)	0	See fault code 1103.	See fault code 1103.
1384	Reticle signal flasher in GCU	75	-1 to +4 (Vdc)	Pulsing	See DVM 75 in table 3-8 for comments.	See fault code 1162.
1385	Trigger	35	+20 to +30 (Vdc)	0	Checks to see when trigger is applied, which is used as a time reference for all other gun functions.	Were trigger and action switches depressed within 15 seconds of RUN key? If yes, check trigger logic per aircraft schematic in TM 55-1520-236/239-23. **M** Check logic relay assembly.
1391	Interlocked trigger	62	-1 to +10 (Vdc)	+20 to +30 (Vdc)	If fault codes 1384 and 1385 were displayed, perform corrective action for those fault codes first. If fault codes 1384 and 1385 were not displayed, perform corrective action for this fault code.	Perform checkout of GCU per paragraph 3-12. Also, refer to DVM 62 in table 3-8 for a description of all interlock signals affecting the interlocked trigger signal. If GCU checks ok, and all interlocks are present, check LCU per paragraph 3-14. Check for shorts in aircraft wiring on interlocked trigger signal if GCU and LCU check out ok.
1392	Feeder solenoid return	25	-1 to +4 (Vdc)	+20 to +30 (Vdc)	This energizes the M89E1 feeder solenoid by supplying a ground. No corrective action required if fault code 1391 occurred.	Test GCU per paragraph 3-12. If faulty, check feeder solenoid outputs for shorts prior to GCU replacement to prevent a second GCU failure due to short circuit.

Table 3-7. System Checkout Fault Codes — Continued

Step	A7	Gun Trigger Application Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1393	Gun drive relay return	27	-1 to +4 (Vdc)	+20 to +30 (Vdc)	This signal activates the gun drive relay 19K5 via overload sensors, gun motor circuit breaker (19CB8) and the LCU.	Test GCU per paragraph 3-12. Check aircraft wiring per schematic in TM 55-1520-236/239-23.
1394	Gun drive relay circuit through the LCU.	34	-1 to +4 (Vdc)	+20 to +30 (Vdc)	See fault code 1393.	Test LCU per paragraph 3-14. Check aircraft relay 19K5 coil wiring per schematic in TM 55-1520-236/239-23.
1395	Fire volts relay return	26	-1 to +4 (Vdc)	+20 to +30 (Vdc)	Picks up fire volts relay in GCU when 0 Vdc. Requires a normal interlocked trigger signal. No external problems can cause failure in this fault code.	Replace GCU.
1410	Fire volts sensor	30	See comments	Steady 28 Vdc Steady 0 Vdc	This signal is generated by the rounds fire simulator (under test conditions) and the GCU. This fault code is caused by an improper firing rate. A proper firing rate results in a 28 volt pulse of 4 milliseconds duration which occurs every 80 milliseconds.	Check CGU per paragraph 3-12. Verify that rounds fire simulator is connected. Check W2 cable on turret. Check GCU per paragraph 3-12. If problem persists, replace firing simulator (part of test set).
1411	Torque command signal	32	+20 to +30 (Vdc)	0	This signal is produced from fire volts sensor of the GCU (affected by the rounds fire simulator) and its summation to the GCU generated interlocked trigger at the LCU.	Test LCU per paragraph 3-14 if fault code 1391 and 1410 did not appear. Check aircraft wiring for shorts on torque command output from LCU (pins X and Q of connector 19A5P2). Refer to schematic in TM 55-1520-236/239-23.

Table 3-7. System Checkout Fault Codes — Continued

Step	A8	Gun Trigger Release Check				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1430	Trigger	35	0	+28 (Vdc)	Trigger release starts a time dependent monitor sequence to check time delay circuits of the GCU.	Trigger does not release. Check trigger switch for binding condition.
1431	Interlocked trigger	62	+18 to +30 (Vdc)	0		Replace GCU and check for shorts on interlocked trigger input to LCU. Refer to schematic in TM 55-1520-236/239-23.
1432	Feeder solenoid return	25	+18 to +30 (Vdc)	0	See fault code 1392.	Replace GCU.
1433	Gun drive delay	27	(-1 to +4) (Vdc) See comments	See comments	Gun drive delay is too short. Effect will be that weapon returns uncleared from a firing mission whenever a full complement of ammunition is not expended.	Retest this mode (A8 in table 3-6) after checking setup conditions; if same fault code appears, replace GCU.
1434	Fire volts relay return	26	(-1 to +4) (Vdc) See comments	See comments	Fire volts delay is too short. Effect will be that an excessive number of rounds could be cleared in an unfired condition. This fault code could be introduced by an azimuth or elevation error interlock causing the interlocked trigger to change state prior to release of the trigger switch.	See system test point description (table 3-8) for the following DVM codes: 18, 40, 36, 37, 38, 39, 31, 33 and 02. Any one of the above readings, if abnormal, may cause this malfunction. If all the above readings are normal, replace GCU.
1441	Gun drive delay	27	+28 (Vdc)	0	Gun drive delay too long or not dropping out at all.	Test GCU per paragraph 3-12. Check for shorts on gun drive relay 19K5 pin X2 to ground. Refer to system schematic in TM 55-1520-236/239-23.
1442	Fire volts relay return test point at GCU	26	(-1 to +4) (Vdc) See comments	See comments	Fire volts delay on dropout is too short. This signal is measured immediately after gun drive delay (see fault code 1441). Fire volts should remain on slightly longer than gun drive to fire rounds during a normal clearing cycle.	See fault code 1434.

Table 3-7. System Checkout Fault Codes — Continued

Step	A8	Gun Trigger Release Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1442 (cont)					See fault code 1434 for additional comments.	
1451	Fire volts relay return test point at GCU	26	+20 to +30 (Vdc)	-1 to +4 (Vdc)	Fire volts dropout delay is too long. This could be dangerous if the fire volts relay stuck closed.	Has the trigger been reapplied? If not, replace GCU.
1452	Torque command	32	-1 to +4 (Vdc)	+20 to +30 (Vdc)	Torque command should be off because the weapon is not in firing mode.	Replace LCU.
Step	**A9**	**Gunner Stow Position Check**				
1461	Standby relay coil power	46	+20 to +30 (Vdc)	0	Refer to fault code 1100.	
1462	28 Vdc at GCU	45	2.1 to 4.0 (Vdc)	0	Refer to fault code 1101.	
1463	IFCU 28 V PWR ON signal	44	+20 to +30 (Vdc)	0	This is a signal from the standby relay contacts.	Check standby relay 19K38 contacts and aircraft wiring. Refer to TM 55-1520-236/239-23.
1464	HL turret drive motor control voltage	28	+20 to +30 (Vdc)	0	Refer to fault code 1150.	**M** Check logic relay assembly.
1465	115Vac at GCU	22	+100 to +125 (Vac)	0	Refer to fault code 1104.	

Table 3-7. System Checkout Fault Codes — Continued

Step	A9	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1466	28 Vac at GCU	51	+20 to +29 (Vac)	0	Refer to fault code 1105.	
1467	10 Vac at GCU	06	+8 to +12 (Vac)	0	Refer to fault code 1106.	
1468	Burst limit output GCU test	02	+4 to +14 (Vdc)	0	Refer to fault code 1107.	
1471	Regulated 28 Vdc from GCU	29	+24 to +27 (Vdc)	0	Refer to fault code 1108.	
1472	+15 Vdc power supply in LCU	05	+13 to +17 (Vdc)	0	Refer to fault code 1111.	
1473	-15 Vdc power supply in LCU	04	-13 to -17 (Vdc)	0	Refer to fault code 1112.	
1474	+5 Vdc power supply in LCU	03	+4 to +6 (Vdc)	0	Refer to fault code 1113.	
1475	Emergency stow relay return	58	+2.1 to +5.9 (Vdc)	See comments	This relay (K1 in ESU) should have regulated 28 Vdc on terminal X1 from GCU. The TCU should provide a ground through a 39-ohm resistor for the relay X2 terminal if the TCU has functional ±15 Vdc power supplies and HL 28 Vdc.	Test TCU per paragraph 3-13, if ok test GCU per paragraph 3-12. If DVM 58 reading is 0 Vdc, check relay K1 continuity in ESU and its respective wiring per system and turret schematic.
1476	Pitch correction (SCAS) test point of LCU	07	+2.5 to +4 (Vac)	Variable	This signal is a composite of the azimuth and elevation turret resolver outputs generated in the LCU. The null for this signal should occur when turret position is about -20° el and 0° az.	Test LCU per paragraph 3-14. If ok, check turret resolver operation by performing resolver alignment per TM 9-1090-206-30.

Table 3-7. System Checkout Fault Codes — Continued

Step	A9	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1477	Elevation demod TCU	48	-1 to +1 (Vdc)	Variable between ±3 (Vdc)	This should be a null as the turret is servoed.	Test TCU per paragraph 3-13 if turret does not synchronize to 0° az, 0° el. If TCU checks ok, check resolver alignment (TM9-1090-206-30).
1478	Yaw correction (SCAS) test point of LCU	09	+1 to -1 (Vdc)	±6 (Vac)	This is a signal generated by the turret azimuth resolver Sine output appropriately scaled by the LCU.	Test the LCU per paragraph 3-14. If ok, perform resolver alignment per TM 9-1090-206-30.
1481	Azimuth demod of TCU	47	+1 to -1 (Vdc)	±3 (Vac)	This should be a null if the turret is servoed in azimuth. Refer to fault code 1117.	Test TCU per paragraph 3-13. If ok, check resolver alignment per TM 9-1090-206-30.
1482	Azimuth 1.5° detector in LCU	63	+20 to +30 (Vdc)	0	This should be +28 Vdc because the turret is servoed to the 0 degree azimuth position. Refer to fault code 1118.	Perform LCU test per paragraph 3-14.
1483	Gunner stow interrupt	60	+1 to -1 (Vdc)	+2.1 (Vdc) or higher	Lack of action or fixed forward signal to TCU causes this to be a low voltage because relay A8K1 is de-energized without either of these signals.	Measure fixed forward signal by entering DVM 72 on test set. Indication should be 0 (Vdc). If not, test TCU per paragraph 3-13.
1484	90° out-of-coincidence in LCU	61	+1 to -1 (Vdc)	Greater than ±1.6 (Vdc)	This test point is parallel to the LED on the front of the LCU. Visual inspection of LED indicates a condition where the turret azimuth resolver is out of alignment, or the turret resolver is malfunctioning.	If fault code 1196 did not occur, perform LCU test per paragraph 3-14.
1485	Turret limit switch power	41	+20 to +30 (Vdc)	0	See fault code 1143.	

Table 3-7. System Checkout Fault Codes — Continued

Step	A9	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
					NOTE The following general comments are applicable to fault codes 1486, 1487, 1488 and 1491. 1. Turret must not be in any limit 2. Fault code 1485 must be corrected first (if applicable). 3. Check for shorts on limit switch wiring. 4. Prior to replacing switch assembly check for shorts on applicable switch outputs.	Checkout for proper operation may be accomplished by removing turret drive motor power and emergency stow power and manually positioning turret into its respective limits while monitoring that limit switch test point. Adjust limit switch actuators per procedures found in TM 9-1090-206-30.
1486	Right limit switch output	37	+20 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace azimuth switch assembly.
1487	Left limit switch output	36	+20 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace azimuth switch assembly.
1488	Up limit switch output	39	+20 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Check for sticking "dog leg" linkage. Replace elevation switch assembly.
1491	Down limit switch output	38	+16.1 to +30 (Vdc)	0		Inspect for loose or physically damaged switch. Replace elevation switch assembly.
1492	+18 Vdc in IFCU	50	+16 to +20 (Vdc)	0	Check for shorts on IFCU +18 Vdc output to prevent a second IFCU from short circuit failure. A failure in +18 Vdc circuit will cause the GHS and PHS to be non-functional.	Test IFCU per paragraph 3-15. Should IFCU test ok, check aircraft test connector 19J1 wiring. Refer to TM 55-1520-236/239-23.

Table 3-7. System Checkout Fault Codes — Continued

Step	A9	Gunner Stow Position Check — Continued				
Fault Code	**Signal Name System Test Point**	**DVM Address**	**Normal Reading**	**Abnormal Reading**	**Comments**	**Corrective Action**
1493	-18 Vdc in IFCU	49	-16 to -20 (Vdc)	0	Check for shorts on IFCU -18 Vdc output to prevent a second IFCU from short circuit failure. A failure in -18 Vdc circuit will cause GHS and PHS to be non-functional.	Test IFCU per paragraph 3-15. Should IFCU test ok, check aircraft test connector 19J1 wiring. Refer to TM 55-1520-236/239-23.
1501	Depression limit enable signal	73	+20 to +30 (Vdc)	0	The turret depression limit switch provides 28 Vdc to the LCU.	Check test setup conditions in table 3-6 (TURRET DEPR LIMIT E LASER SAFE TURRET DEPR LIMIT M switch on GCP to ON). Test GCP per paragraph 3-16. If ok, check applicable aircraft wiring. Refer to TM 55-1520-236/239-23.
1502	Slow slew enable	65	-1 to +4 (Vdc)	+5.2 (Vdc)	The SLOW SLEW E TUR SLEW M switch provides a ground for the TCU slow slew circuitry.	Check test setup conditions in table 3-6 (on GCP check that E SLEW RATE is set to SLOW. M TUR SLEW is set to GRD TEST.) Test GCP per paragraph 3-16. Test TCU per paragraph 3-13. If these units pass, check aircraft slow slew wiring and ground on pin R of 22A3P1. Refer to TM 55-1520-236/239-23.
1503	Master arm relay coil	43	+20 to +30 (Vdc)	0		Check test setup conditions in table 3-6 (MASTER ARM switch on PCP to ARM). Test PCP per paragraph 3-17. If ok, check applicable aircraft wiring per TM 55-1520-236/239-23.

Table 3-8. System Test Points and Normal Indications

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
01	Depression limit control voltage	Approx -4.1 (Vdc) Approx +12 (Vdc)	Turret not in depression limit mode. When the turret is down 10° in el with sight mechanism directed to a position equal to or lower than the turret, the +12 Vdc turret depression limit voltage is present. With the turret down 10° (and in depression limit) and the sight raised above the turret position, the turret depression limit voltage reverts to its nominal state (-4.1 Vdc).	See conditions explanation for theory and comments.
02	Burst limit timing test point of the GCU	+11.6 (Vdc) -11.6 (Vdc)	No burst limit signal applied. Burst limit signal applied and measurement made 3 seconds after trigger application.	This signal can be used to check the ±12 Vdc power supplies in the GCU as this signal is the output of an operational amplifier.
03	+5 Vdc out of the LCU	+4.9 (Vdc)	System in standby mode.	If DVM 44 reading is ok (28 Vdc LL), LCU is faulty. This power supply is used only for the torque signal command.
04	-15 Vdc power supply from LCU	-15 (Vdc)	System in standby mode.	Operates from 115 Vac out of GCU.
05	+15 Vdc power supply from LCU	+15 (Vdc)	System in standby mode.	Operates from 115 Vac out of GCU.
06	10 Vac, 400 Hz reference	+10.3 (Vac)	System in standby mode.	Used for excitation to the turret resolvers. This is generated from the 26 Vac transformer via a voltage divider and a 400 Hz tuned filter in the GCU.

* DVM addresses are identified in figure FO-1.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
07	Pitch correction for SCAS	+2.2 (Vac) at 0° az, 0° el. Variable dependent on turret position and LCU switch setting	System in standby mode.	A null should appear at a turret down position of -20° to -24° el and 0° az. Above that position the phase of the signal is positive. When azimuth of the turret is 90° either side of forward and elevation is 0°, this signal is also a null.
08	Roll correction for SCAS	+4.7 (Vac) at 90° left, variable with turret position	System in standby mode.	Roll is dependent upon the turret elevation position when off 0° axis in azimuth. A negative phase occurs with the turret to the right of 0°.
09	YAW correction SCAS	+4.7 (Vac) at 90° left	System in standby mode.	This signal is similar to roll.
10	Elevation error to LCU	Null Variable. Down drive command gives a minus phase and an up drive command gives a plus phase.	System in standby mode and the turret is controlled by one of the sight mechanisms.	This signal represents the elevation axis misalignment between the turret and the sight mechanism. With the servos energized a null occurs. This signal is modified by the LCU for depression limit control; therefore either a failure in the TCU or the LCU or the servo resolver chain can cause this signal to be unzeroed.
11	Depression limit output	Null	System in standby mode, controlled with a sight mechanism.	This is the output of the LCU from DVM 10 signal. In depression limit enable, this signal should null when turret is depressed about -5° down and the sight is depressed below -5° down.
E 12	V_h unscaled	Approx +3.1 (Vac)	Airspeed indicator set up to read 100 knots using airspeed simulator on pitot system.	This signal is the airspeed compensation excitation voltage from the pressure transducer via the buffer amplifier A6 in the aircraft.
13	TSU range reference	+3.8 (Vac)	Turret servoed to 0° az, 0° el by the TSU.	This is the final resolver chain signal. A failure in any portion of this chain will cause an abnormal indication. This signal is also used by the 180° out of coincidence signal (DVM 15) of the LCU when the TSU is controlling the turret.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
E 14	Super elev (range drop correction)	-0.2 (Vac) Approx 0.0 (Vac) Approx +0.2 (Vac) Approx +0.4 (Vac)	Turret at 0° az, 0° el and TSU/ TRACK and STBY mode ARMED mode with RANGE set to SHORT ARMED mode with RANGE Set to MED ARMED mode with RANGE set to LONG	This signal is generated by the IFCU scaling circuits and the TSU range reference voltage. This signal is disabled by the range enable relay (19K102) if not in the ARMED mode.
15	Selected "Q"	+3.8 (Vac)	Same as DVM address 13, depending on which sight unit is used to control the turret.	This signal is used to determine which of the range reference signals are used by the LCU coincidence control circuit to detect an out of alignment by more than 180°. This test point can be used to determine whether one sight mechanism is faulty by lack of this signal's occurrence. It could also indicate faulty LCU relay selection of the appropriate sight mechanism.
18	Azimuth error interlock	+15.5 (Vdc) Approx 0 (Vdc)	Normal (uninterrupted) Interrupted	This signal is controlled by the following functions: 1. Azimuth 1.5° (DVM 63) 2. Coincidence circuit (DVM 61) 3. Gunner stow (DVM 60) 4. Depression limit (DVM 01) If this signal is interrupted, fault isolation to the function causing that interruption must be performed.
19	Fire voltage	Approx 0 (Vdc) Approx +358 (Vdc)	Non-firing Trigger applied in ARMED mode	This signal should remain ON for approx 1.5 seconds after trigger release. If this signal is abnormal and DVM 66 indication (interlocked trigger) is normal, the GCU is faulty.
21	26 Vac reference from LCU	-27.8 (Vac)	Standby mode	If DVM 22 indication is ok, the LCU is faulty.
22	115 Vac input power	+111.3 (Vac)	Standby mode.	Standby relay faulty if DVM 45 indication is nominal.
24	115 Vac to the IFCU	+116.3 (Vac)	Standby mode.	Faulty standby relay 19K38.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
25	Feeder solenoid return	0 +23.4 (Vdc) 0	Non-firing standby. Non-firing armed Firing (trigger applied).	This is a signal which goes low when firing. In parallel with the feeder solenoid is the ammo booster relay coil.
26	Fire volts relay coil	+23.2 (Vdc) +1.0 (Vdc)	Non-firing. Firing (trigger applied).	The fire voltage output (DVM 19) is controlled by the contacts of this relay.
27	Gun drive relay return	+23.2 (Vdc) +1.2 (Vdc)	Non-firing. Firing.	This is one of the two gun drive relay signals. This one is at the GCU, the other is at the LCU. The active device, a transistor, is located in the GCU. This transistor pulls the low end of the gun drive relay to ground. The relay return enters the GCU via aircraft wiring and through an interconnecting wire in the LCU. This input to the LCU is obtainable on DVM 34. This signal should remain low for approximately 1 second after trigger release.
28	HL 28 Vdc control	+23.0 (Vdc)	See comments.	This is a delay of approximately 4 seconds after application of the standby signal. This delay is initiated by a timing circuit in the GCU regulated 28 Vdc power supply (DVM 29). This delay holds off the turret drive motor power until the resolver buffer amplifiers have stabilized.
29	28 Vdc regulated	+25.3 (Vdc)	Standby mode.	This power supply is used to power the resolver buffer amplifiers, emergency stow relay control, and the pitch and roll alignment resolvers internal to the IFCU. The lower nominal voltage indication is due to the series resistance in the test point. This voltage may be monitored and adjusted when GCU is connected to test set. Refer to TM9-1090-206-30.
30	Fire volts signal input	+23.0 (Vdc) 0 (Vdc)	Non-firing. Firing.	This signal is generated by the GCU and is also used by the LCU to generate the torque command for SCAS. The fire volts signal can be measured without the rounds fire simulator being installed.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
31	Rocket lockout (wing stores trigger)	+25.5 (Vdc) 0	Wing stores trigger applied. Wing stores trigger not applied.	This test point is used only to determine whether weapon firing has been interrupted by the rocket lockout signal. This signal immediately causes gun fire to cease. Gun firing will resume 1.0 ±0.5 seconds after the wing stores trigger signal has been removed.
32	Torque command	0 +25.2 (Vdc)	Non-firing. Firing (with rounds fire simulator connected to W2P3).	This signal enables the SCAS unit to utilize the pitch, roll, and yaw signals from the LCU for aircraft attitude corrections due to gun induced forces. This circuitry of the LCU requires a round-by-round signal from the fire volts sensor (DVM 30) and an interlocked trigger signal to generate a proper output. The round-by-round signal is generated in test/checkout by the rounds fire simulator (P/N 11830648). In normal aircraft operation this round-by-round function is performed by the actual ammunition.
33	Burst limit signal input	+25.8 (Vdc) 0	In burst limit mode (1st detent of aircraft trigger). In non-burst limit mode (2nd detent of aircraft trigger).	Check aircraft relay 19K8 or the trigger for proper operation of trigger switches. Relay 19K8 is energized in the 2nd detent mode of the actual trigger switch being used.
34	Gun drive relay return at the LCU	+25.5 (Vdc)	See DVM 27 for description.	
35	Trigger	+25.5 (Vdc)	Trigger applied in either first or second detent. (MASTER ARM on PCP set to ARM.)	
36	Left limit	+19.5 (Vdc)	Turret not in limit while under sight control.	Check limit switch power (DVM 41)
37	Right limit	+19.5 (Vdc)	Turret not in limit while under sight control.	Check limit switch power (DVM 41).
38	Down limit	+19.5 (Vdc)	Turret not in limit while under sight control.	Check limit switch power (DVM 41).
39	Up limit	+21.1 (Vdc)	Turret not in limit while under sight control.	Check limit switch power (DVM 41).

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
36 thru 39		0	Turret in limit.	Faulty limit switch will give similar indication (0 Vdc).
36 thru 39		+24.1 (Vdc)	Fixed forward mode.	Check fixed forward mode (DVM 72) (limit switch actuation will not generate a "low" as the signal is forced "high" in the TCU by the fixed forward signal).
40	Elevation error interrupt	+16.6 (Vdc) 0	Turret servoed to the sight mechanism. Turret out of coincidence in excess of 1.5°. Use slow slew to accomplish this or a large step function in excess of 10 to 15° elevation.	This signal should be high when the turret is aligned and the demodulator is less than 0.5 Vdc of either polarity. If this signal is low and the elevation demodulator (DVM 48) is nulled, the 1.5° elevation error circuitry in the LCU has failed.
41	Limit switch power	+22.0 (Vdc)	Gunner in control, standby/ non-action.	This signal is on the output of the TCU. This supply is protected by a 32 Vdc zener regulator and a series resistor of 27 ohms. A blocking diode and filter capacitor are located on the A1 board of the TCU. Input power for this circuit is obtained from the GCU.
42	Track signal	+25.3 (Vdc) 0	STOW/TRK/ACQ switch in TRK position On SHC	Check SHC switch.
43	Arm relay coil power	+25.8 (Vdc) 0 +25.8 (Vdc)	In arm mode. In standby mode. In pilot override mode.	Check MASTER ARM switch on PCP. Check PLT ORIDE switch on GCP.
44	28 Vdc LL for LCU	+25.5 (Vdc)	Standby or armed mode.	The source of this voltage is GCU.
45	28 Vdc LL at the GCU	+2.3 (Vdc)	Standby or armed mode.	There is a 1K load resistor and a 10K source resistor, which explains the very low indication. Check standby relay 19K38 coil power and 19CB1. Refer to the aircraft schematic in TM 55-1520-236/239-23.
46	Standby relay coil power	+26 (Vdc)	Standby mode.	Check the pilot MASTER ARM switch. Check aircraft wiring. Refer to schematic in TM 55-1520-236/239-23.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
47	Azimuth demodulator	Variable, a positive polarity occurs when turret is to the right of its commanded position.	See comments.	This signal can be used to zero or align the resolvers, checkout the TCU input circuitry and the power supplies. The maximum signal which is available from this test point is approximately 3 Vdc of either polarity. With the servos energized this signal should remain nulled.
48	Elevation demodulator	Variable, a positive polarity occurs when the turret is at a lower position than its commanded position.	See comments.	This signal is similar to the azimuth demodulator. This circuit transforms on ac input to either a positive or negative dc voltage, dependent upon which phase error signal is present at the TCU input.
49	-18 Vdc power supply of the IFCU	-18.0 (Vdc)	Standby mode.	This power supply needs only +28 Vdc standby and IFCU 115 Vac power to operate. (See DVM 46 and 24 respectively.)
50	+18 Vdc power supply of the IFCU	+18.0 (Vdc)	See DVM 49.	See DVM 49.
51	26 Vac reference	+25.6 (Vac)	Standby mode.	This signal is used to provide a demodulator reference from the GCU to both the TCU and LCU. It is generated from 115 Vac and 28 Vdc standby power into the GCU.
58	Emergency stow relay return	+4.2 (Vdc) 0 +26 (Vdc)	Fixed forward servos energized. Turret PWR 115 Vac circuit breaker (196B4) out. HL 28 Vdc power OFF.	This test point, if higher than 20 Vdc, indicates a failure in the TCU low voltage cutout circuitry. If it is a 0 Vdc the problem is an open relay coil or its associated wiring, or the regulated 28 Vdc has malfunctioned (check DVM 29 for this voltage). If the voltage on DVM 58 is high, the TCU should have shut off, resulting in no servo action.
59	Coincidence low	0	Servos activated and aligned to commanded position.	Check reticle bypass relay 19K101 per TM 55-1520-236/239-23. Check GCU flasher test point (DVM 75).

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
60	Gunner stow interruption to the GCU	0 +3.0 (Vdc) 0 -3.3 (Vdc)	Gunner stow. Action aligned. Action misaligned by more than 4.5° or 28 Vdc HL off. In depression limit.	Three functions control this signal: 1. TCU action or fixed signal. 2. Elevation 4.5° detector in the TCU. 3. Depression limit interlock. These can be verified by DVM addresses 71, 72, or 01.
61	90° detector	0 +1.6 (Vdc)	Aligned. Misaligned by more than 90°.	This signal is in parallel with the LED on the LCU. The illumination of the LED may be accomplished by setting the system to the fixed forward mode and leaving turret drive motor power off. Manually position the turret to either right or left azimuth in excess of 90°.
62	Interlocked trigger	+25.5 (Vdc) +5.4 (Vdc)	No trigger applied or the trigger has been locked out by some interrupting signal. Trigger applied and all interlocks are acceptable.	This test point is the final signal of the weapon control circuitry which drives the actual functions to initiate weapon firing. All of the interlocks, except rocket lockout, listed below must be high and the trigger applied for this signal must be low. DVM 39 Signal Name: Up limit — Normal Indication: +20 (Vdc) 38 Dn limit +20 (Vdc) 37 Rt limit +20 (Vdc) 36 Lt limit +20 (Vdc) 18 Az error +16 (Vdc) 40 El error +17 (Vdc) 02 Burst limit +11.7 (Vdc) 31 Rocket lockout 0 (Vdc) 35 Trigger +27 (Vdc)
63	Azimuth 1.5° error detector	+14.1 (Vdc) 0	Servos aligned to commanded position. Out of coincidence.	This circuit's function is to prevent weapon firing whenever the actual and commanded turret positions differ in excess of 1.5°. The input to the LCU for this function is the azimuth demodulator from the TCU. If the azimuth demodulator output is in excess of 0.5 Vdc of either polarity, and this test point has not switched to a low state, the LCU is faulty.

Table 3-8. System Test Points and Normal Indication — Continued

* DVM Address	Signal Name	Nominal Indication	Conditions	Comments
65	Slow slew enable	0 +5.4 (Vdc)	Enabled (slow slew). Normal.	The slow slew switch on the GCP provides a ground for some low-level circuitry in the TCU for slow slew operation.
E 68	Compensation signal	+26.0 (Vdc)	A/S COMPEN switch on GCP set to COMPEN.	These signals are used to verify that all mode select signals required by the IFCU are present when required. These provide a method by which fault isolation of a mode related malfunction to either the IFCU or aircraft wiring can be accomplished.
69	Gunner ACQ	+26.0 (Vdc)	Gunner ACQ mode selected	
70	Pilot ACQ	+26.0 (Vdc)	Pilot ACQ mode selected	
71	Action signal to the TCU	+26.0 (Vdc) 0	Action switch is depressed. Action switch released	Used to verify that the TCU and the reticle bypass relay (19K101) have received this command signal.
72	Pilot/ fixed	+28 (Vdc)	FIXED mode selected on the PCP.	This signal is used to verify aircraft wiring and mode selection circuitry is functional prior to fault isolating individual LRU's.
73	Depression limit enable	+26.0 (Vdc)	TURRET DEPR LIMIT E LASER SAFE/ TURRET DEPR LIMIT M switch on GCP is on.	Aircraft checkout of this control panel switch function may be accomplished with this test point. This signal is disabled by the fixed forward signal (DVM 72).
75	Flasher	0 0 Pulsing 0 to +26 (Vdc)	Non-action mode. Action mode with a selected sight mechanism in alignment. Action mode out of coincidence or the turret in one of its limits.	Disabled by reticle-bypass relay 19K101. The GCU provides a ground return when aligned. The GCU provides an intermittent ground for the reticle return.
76	TOW	+26 (Vdc)	TOW mode selected on the tow control panel.	Checkout of system mode signals including aircraft wiring. Refer to schematic in TM 55-1520-236/239-23.

Table 3-9. M89E1 Feeder Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

WARNING

When performing troubleshooting, clear/safe M89E1 feeder, M197 gun, feed system, and turret. Observe all precautions governing care and handling of live ammunition.

1. FEEDER WILL NOT FEED (GUN IS FREE TO ROTATE).

Step 1. Check to see if W2P1 is connected to W3J1 at aft end of saddle.
Reconnect W2P1.

Step 2. Check to see if power is present at W2P2.
Perform system checkout. Refer to table 3-5.

Step 3. Check solenoid for proper operation.
Perform system checkout. Refer to table 3-5.

Step 4. Check for link separation.
Replace damaged links.

Step 5. Check for missing feeder mounting pin.
Replace as necessary.

Step 6. Check for loose solenoid mounting bolts.
Tighten bolts. Torque to 45 to 60 lb-in.

Step 7. Visually check for mistimed (improperly assembled) parts of feeder.
Disassemble and reinstall parts in properly timed position.

Step 8. Check for loose cap mounting bolts.
Tighten bolts. Torque to 80 to 90 lb-in.

Step 9. Check for missing solenoid-to-arm connecting pin.
Replace as necessary.

Step 10. Inspect for worn clutch parts.
Disassemble and replace worn parts as necessary.

Step 11. Check for missing controlling wedge alignment pin.
Replace as necessary.

Step 12. Check for missing arm pivot bolt.
Replace as necessary.

Table 3-9. M89E1 Feeder Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 13. Check for broken gear teeth.	Replace as necessary.
	Step 14. Inspect for dirt behind plunger in solenoid.	Disassemble solenoid, clean, and reinstall.
2. FEEDER WILL NOT FEED (GUN IS NOT FREE TO ROTATE).		
	Step 1. Check for jammed gun.	Clear/safe gun in accordance with paragraph 2-7.
	Step 2. Check for round jammed in feeder caused by link not engaging in stripper.	Replace stripper if bent or damaged.
	WARNING Observe all precautions governing care and handling of live ammunition.	
	Step 3. Check for jammed feeder caused by sprockets puncturing a round.	Disassemble and check for bent sprockets. Replace sprockets if bent or damaged.
	Step 4. Check for link stuck in T-bar guide.	Disassemble and inspect T-bar guide and stripper for damage. Repair damaged parts as necessary.
	Step 5. Feeder out of time with gun.	Remove feeder, time it to gun, and reinstall.
	Step 6. Check for dirt in clutch mechanism.	Disassemble and clean as necessary.
	Step 7. Check for defective bearings.	Disassemble and replace damaged parts as necessary.
	Step 8. Visually check for mistimed (improperly assembled) parts of feeder.	Disassemble and reinstall parts in properly timed position.
3. FEEDER WILL NOT DECLUTCH.		
	Step 1. Check to see if power is applied continuously to solenoid.	Perform system checkout. Refer to table 3-5.
	Step 2. Check for foreign matter between wedge and feeder housing.	Remove obstructions.

Table 3-9. M89E1 Feeder Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
	Step 3.	Check for dirty clutch parts. Disassemble and clean as necessary.
	Step 4.	Check for broken or missing spring behind plunger in solenoid. Replace as necessary.
	Step 5.	Check for foreign matter between cap and gear. Disassemble and clean as necessary.
	Step 6.	Check for foreign matter between pin and wedge. Disassemble and clean as necessary.
4. FEEDER FEEDS ERRATICALLY.		
	Step 1.	Check for dirty connector pins. Clean as necessary.
	Step 2.	Check to see if power is applied intermittently to solenoid. Perform system checkout. Refer to table 3-5.
	Step 3.	Check solenoid for proper operation. Perform system checkout. Refer to table 3-5.
	Step 4.	Check for loose solenoid mounting bolts. Tighten bolts. Torque to 45 to 60 lb-in.

Table 3-10. M197 Gun Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

WARNING

When performing troubleshooting, clear/safe M89E1 feeder, M197 gun, feed system and turret. Observe all precautions governing care and handling of live ammunition.

1. FIRING CIRCUIT SHORTED.
 - Step 1. Test breech bolt for short circuit and check breech bolt components. Refer to paragraphs 3-33b(10) and 3-33b.1(11), and table 3-12.
 Replace defective breech bolt firing circuit components.
 - Step 2. Test firing contact for short circuit and check firing contact components. Refer to paragraph 3-33c(8) and table 3-12.
 Replace defective firing contact components.

2. FIRING CIRCUIT OPEN.
 - Step 1. Test breech bolt for open circuit and check breech bolt components. Refer to paragraphs 3-33b(10) and 3-33b.1(11), and table 3-12.
 Replace defective breech bolt firing circuit components.
 - Step 2. Test firing contact for open circuit and check firing contact components. Refer to paragraph 3-33c(8) and table 3-12.

3. HIGH ROTATING TORQUE (IN EXCESS OF 100 LB-IN.).
 - Step 1. Check for lack of lubrication.
 Lubricate M197 gun. Refer to LO9-1090-206-12.
 - Step 2. Check for defective breech bolt. Refer to table 3-12.
 Repair/replace as necessary.
 - Step 3. Check for defective unlocking cams. Refer to table 3-12.
 Replace.
 - Step 4. Check for defective ball bearing or needle bearing.
 Return M197 gun to next higher maintenance level for repair.

4. GUN WILL NOT TURN.
 - Step 1. Check for improperly installed breech bolt(s).
 Reinstall breech bolt(s). Refer to paragraph 3-33e(14 thru 18).
 - Step 2. Check for improperly assembled breech bolt(s).
 Reassemble breech bolt(s). Refer to paragraphs 3-33b and 3-33b.1.

Table 3-10. M197 Gun Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
4. GUN WILL NOT TURN. - cont.		
	Step 3. Check for two breech bolts installed on same set of tracks.	Return M197 gun to next higher maintenance level for repair.
	Step 4. Check for improperly installed tracks.	Reinstall tracks. Refer to paragraph 3-33e.
	Step 5. Check for foreign object in gun housing.	Remove foreign object.
5. GUN FIRES SLOWLY OR ERRATICALLY.		
	Step 1. Check for lack of lubrication.	Lubricate M197 gun. Refer to LO9-1090-206-12.
	Step 2. Check for bent or damaged guide bar. Refer to table 3-12.	Replace.
	Step 3. Check for defective ball bearing or needle bearing.	Return M197 gun to next higher maintenance level for repair.
	Step 4. Check for high rotating torque.	Refer to high rotating torque malfunction in this table.
	Step 5. Check for defective drive motor.	Replace.
6. GUN DOES NOT FIRE.		
	Step 1. Test breech bolts and firing contact for shorted or open firing circuit. Refer to paragraphs 3-33b(10), 3-33b.1(11, and 3-40c(8). Check breech bolt and firing contact components. Refer to table 3-12.	Replace defective firing circuit components.
	Step 2. Check for worn or damaged contact cam. Refer to table 3-12.	Replace.
	Step 3. Check for defective contact cam springs. Refer to table 3-12.	Replace.
7. HANGFIRES OR MISFIRES.		
	Step 1. Check for worn, damaged, or improperly assembled firing circuit components. Refer to table 3-12 and paragraphs 3-33b, 3-33b.1, and 3-33c.	Replace defective firing circuit components.
	Step 2. Check for defective ammunition.	Change to a different lot of ammunition.

Table 3-10. M197 Gun Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
7. HANGFIRES OR MISFIRES. - cont.	Step 3. Check breech bolt(s) for worn firing pin. Refer to paragraphs 3-33b(9) and 3-33b.1(9).	Replace defective component.
8. ROUND(S) FIRING OUT OF LOCK.	Step 1. Check for improperly installed firing contact.	Reinstall firing contact. Refer to paragraph 3-33e(20 through 22).
	Step 2. Check for evidence of hangfires or misfires.	Refer to hangfires or misfires malfunction in this table.
	Step 3. Check for worn or damaged breech bolts. Refer to table 3-12.	Repair/replace as necessary.
9. SPENT CASES ARE NOT EXTRACTED.	Step 1. Check breech bolt(s) for broken or damaged extractor lip.	Replace defective breech bolt(s).
	Step 2. Check for cartridge case(s) which has separated and lodged in chamber and inspect barrels. Refer to table 3-12 and paragraph 3-31c.	Replace.
10. SPENT CASES ARE NOT EJECTED.	Step 1. Check for damaged guide bar. Refer to table 3-12.	Replace.
	Step 2. Check breech bolt(s) for broken or damaged extractor lip.	Replace defective breech bolt(s).
11. ERRATIC DISPERSION PATTERN.	Step 1. Check for loose muzzle clamp bolt.	Torque muzzle clamp bolt to 750 to 950 lb-in.
	Step 2. Check for worn barrels. Refer to table 3-12 and paragraph 3-31c.	Replace.
	Step 3. Notify next higher maintenance level to check preload of recoil adapter and check recoil adapter components.	
	Step 4. Notify next higher maintenance level to check for worn or damaged slider.	

Table 3-10. M197 Gun Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
12. APPARENT EXCESSIVE GUN VIBRATION.		
	Step 1. Check for improperly assembled gun. Refer to paragraph 3-33.	Repair as necessary.
	Step 2. Notify next higher maintenance level to check for worn or damaged rear mount (on saddle).	

Table 3-11. Turret System Troubleshooting

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION

WARNING

When performing troubleshooting, clear/safe M89E1 feeder, M197 gun, feed system, and turret. Observe all precautions governing care and handling of live ammunition.

1. TURRET CHATTERS IN ELEVATION.
 Check for sticking/dragging elevation drive motor brake.
 Notify next higher maintenance level to replace drive motor.

2. TURRET CHATTERS IN AZIMUTH.
 Check for sticking/dragging azimuth drive motor brake.
 Notify next higher maintenance level to replace azimuth drive.

3. TURRET BINDS IN AZIMUTH.
 Step 1. Check for sticking/dragging azimuth drive motor brake.
 Notify next higher maintenance level to replace azimuth drive.
 Step 2. Dirty or defective main bearing.
 Notify next higher maintenance level to replace turret.

4. M197 GUN FAILS TO ROTATE/FIRE.
 Step 1. M89E1 feeder out of time with M197 gun.
 Remove M89E1 feeder, time it to gun, and reinstall. Refer to paragraph 3-25.
 Step 2. Check for jammed M89E1 feeder/M197 gun.
 Clear jam.
 Step 3. Check for inoperative gun drive.
 Perform system checkout. Refer to table 3-5.

5. TURRET FAILS TO DRIVE IN UP ELEVATION.
 Step 1. Check for defective elevation drive motor.
 Perform system checkout. Refer to table 3-5.
 Step 2. Check for defective elevation drive clutch.
 Notify next higher maintenance level to replace.

6. ERRATIC DISPERSION.
 Step 1. Check for loose ball mount.
 Tighten ball mount mounting bolt. Torque to 130 to 140 lb-in. and lockwire.

Table 3-11. Turret System Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
6. ERATIC DISPERSION — cont.		
	Step 2. Check for worn ball mount.	Notify next higher maintenance level to replace.
	Step 3. Check for loose rear support.	Notify next higher maintenance level to repair.
	Step 4. Check for loose mounting of saddle in turret.	Notify next higher maintenance level to correct defective condition or replace turret.
7. TURRET CAN BE MOVED WITH AZIMUTH AND ELEVATION BRAKES APPLIED.		
	Step 1. Check for defective azimuth or elevation drive motor brakes.	Notify next higher maintenance level to replace azimuth drive or elevation drive motor.
	Step 2. Check for defective azimuth or elevation drive clutch.	Notify next higher maintenance level to replace.
8. UNABLE TO RETAIN BORESIGHT.		
	Step 1. Check for loose muzzle clamp.	Tighten muzzle clamp bolt. Torque to 750 to 950 lb-in.
	Step 2. Check for defective resolver(s).	Perform system checkout. Refer to table 3-5.
9. AMMUNITION BELT SEPARATION.		
	Step 1. Check for defective feed chute.	Repair or replace as necessary. Refer to paragraph 3-66b.
	Step 2. Check for improperly loaded ammunition box.	Reload ammunition box. Refer to paragraph 3-66b.
	Step 3. Check for inoperative booster.	Perform system checkout. Refer to table 3-5.
	Step 4. Check for defective booster motor.	Perform system checkout. Refer to table 3-5.
	Step 5. Check for binding in bellmouth.	Replace as necessary. Refer to paragraph 3-66c.
	Step 6. Check for damaged adapter.	Replace as necessary. Refer to paragraph 3-66d.

Table 3-11. Turret System Troubleshooting — Continued

MALFUNCTION	TEST OR INSPECTION	CORRECTIVE ACTION
10. EXCESSIVE AIRCRAFT VIBRATION DURING GUN FIRING.	Step 1. Check for defective recoil adapter.	Repair or repalce as necessary. Refer to paragraph 3-41.
	Step 2. Check for defective slider.	Repair or replace as necessary. Refer to paragraph 3-41.
11. **M** TURRET POSITION DOES NOT SLEW TO AGREE WITH SIGHT POSITION AND/OR DIRECTION OF LOS.	Step 1. Check for defective turret buffer amplifier using bypass cable. Refer to paragraph 3-17.1.	Replace turret buffer amplifier if bypass indicates it is defective. Refer to paragraph 3-122.

3-10. System Block Diagram Functional Analysis.

a. *General.* The turret system functionally consists of four major blocks: pilot/gunner fire control; sight control; weapon control; and turret positioning (see figures 3-2, 3-2.1, FO-3, FO-4 and FO-4.1). The pilot/gunner fire control provides selection of the operator (pilot or gunner) who has control of the turret system and who may fire the weapon. The sight control portion of the system is comprised of the stabilized telescopic sight (TSU), the gunner helmet sight (GHS), pilot helmet sight (PHS) and the interface control unit (IFCU). The sight control permits the operator to sight in on a target and position the turret in azimuth and elevation relative to that target. Any one of the three sight mechanisms mentioned may be used to aim the weapon depending upon control switch selections available to the pilot and gunner. The gun control provides the circuits necessary to fire the gun. Included in the gun control are time delays, trigger interlocks, gun clearing, and some system-related power supplies. Some of the gun firing interlock circuits are located in a separate assembly called the logic control. Within the logic control are the following fire interrupt logics: azimuth and elevation synchronization detectors; gunner stow interrupt; depression limit interrupt; out of coincidence; and IFCU power supply failure interrupt. The gun control receives a trigger from the mode-dependent trigger switch. Burst limiting and simultaneous firing of the gun and rockets is also provided by the gun control function. Gun recoil induced aircraft altitude changes are minimized by circuits which interface with the aircraft stabilized control augmentation system (SCAS). The pitch, yaw, and roll torque signals are dependent upon turret position, and are utilized by the aircraft when a torque command signal is present. The turret positioning circuits position the turret in fixed forward (0° az, 0° el) and gunner stow (0° az, 11° el) positions, and also in a track or flexible mode to the selected sight line-of-sight. The turret control also provides signals to the gun control indicating an out-of-coincidence (weapon to sight) condition, weapon in depression limit, weapon in gunner stow, weapon in an azimuth or elevation limit, and a defect in the interface control unit. Whenever any of these indications are present, the weapon cannot be fired. Also included in the turret positioning circuits is a backup provision to stow the turret in an upper forward position in the event of primary position control failure.

b. *Operating Modes.* The turret system is functionally enabled in the following operating modes:

(1) *Gunner TSU.* The gunner positions the turret and telescopic sight unit with the sight hand control transducer stick.

(2) *Gunner HSS.* The gunner positions the turret with his helmet sight system.

(3) *Pilot Override.* By placing the pilot override switch on the gunner armament control panel to PLT ORIDE position the gunner overrides the pilot in either PILOT or FIXED mode of the WPN CONTR switch. The gunner then takes control of the turret with his helmet sight system.

(4) *Pilot HSS.* This mode gives the pilot control of the turret when the WPN CONTR switch is placed to PILOT position.

(5) *Fixed.* When the WPN CONTR switch is placed to FIXED position the gun is fixed at 0° az, 0° el and the pilot fires the gun with his cyclic stick trigger.

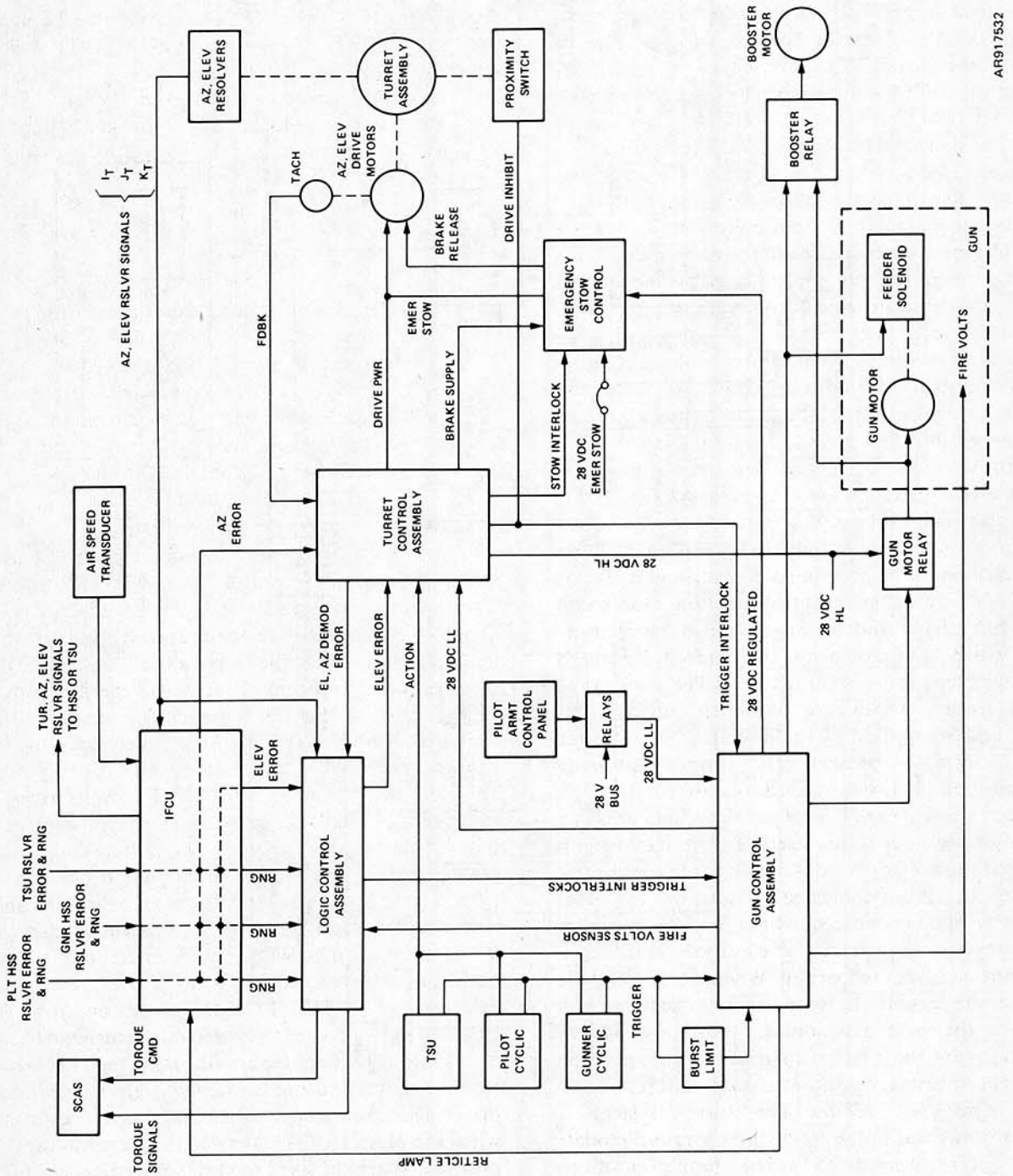
NOTE

A description of the various armament configurations and firing modes are contained in the TM 55-1520-236-10 manual. Also, a complete wiring diagram, showing interface between the turret system and the aircraft power and control wiring, is contained in the TM 55-1520-236/239-23 manual.

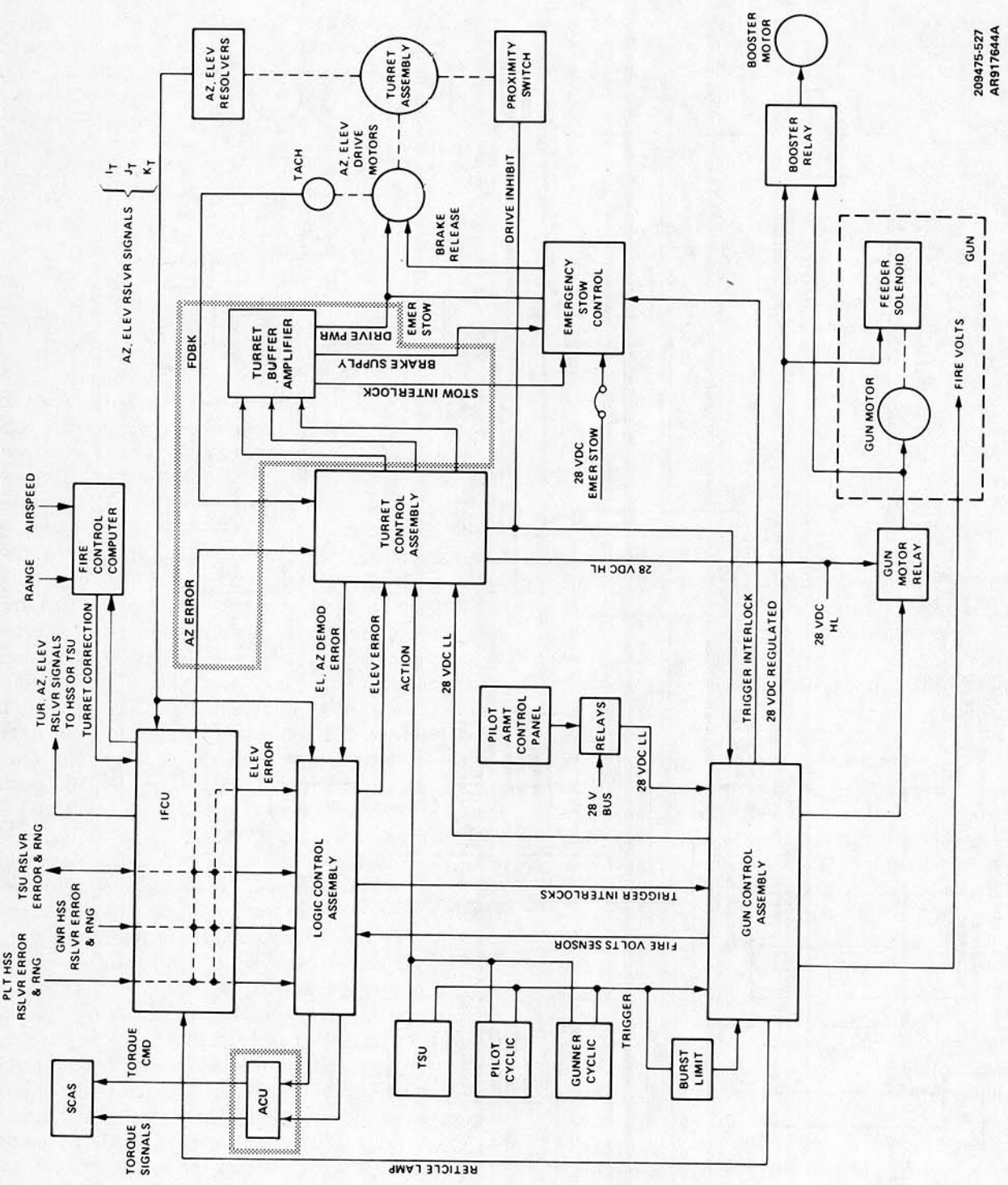
c. *Standby Mode.* Placing the MASTER ARM switch on the pilot control panel to STBY energizes standby relay. With standby relay energized, 28 Vdc LL is applied from aircraft CB1 to the 28-volt regulated supply in the gun control. At the end of a time delay of 2.2 to 5.5 seconds A4K2 in the gun control will energize provided 115 Vac and 28 Vdc LL is present in the gun control. This time delay and voltage interlock is necessary to assure proper operation of the turret when turret power is applied. With aircraft TURRET PWR relay K7 energized, 28 Vdc HL is enabled to the turret control, gun motor, and booster motor. The turret may now be positioned, but the trigger circuits are disabled at this time. The turret is slaved to the telescopic sight unit or helmet sight systems when the action switch is depressed. When the action switch is released the turret is automatically positioned to 0° az, 11° el.

(1) The FIXED mode on the WPN CONTR switch is used to command the turret to 0° az, 0° el position. This position is utilized by the pilot when he would not want to use his helmet sight to position the turret. This fixed mode could be used as a strafing attack when the MASTER ARM switch is placed in the ARM position. When the fixed mode is selected, relay A6A1K1 in the turret control is energized. When that relay is energized, the action (track) relays cannot be activated.

(2) When the WPN CONTR switch is in GUNNER position, the gunner has two sighting



E *Figure 3-2. Turret System Simplified Block Diagram*



M *Figure 3-2.1 Turret System Simplified Block Diagram*

mechanisms to use for turret positioning; the telescopic sight unit or his helmet sight subsystem. When the TOW control panel mode select switch is set to TSU/GUNS, the weapon turret can be slaved to the telescopic sight unit line-of-sight (LOS). All other TOW system modes would cause the helmet sight subsystem to direct the turret position. The GUNNER mode action switch is located on the left hand grip. This action switch can slave the turret to either sight mechanism.

(3) The PILOT mode allows the pilot helmet sight to direct the weapon turret position. The turret is slaved to the helmet sight LOS when the pilot cyclic stick action switch is depressed.

d. *Arm Modes.* The same modes of operation exist as outlined in the standby mode except that the trigger and firing circuits have been energized by the MASTER ARM switch. The trigger circuits are interlocked to the status conditions of the mode switches to prevent inadvertent firing of the weapon. The wing store triggers cannot be utilized unless the turret azimuth stow switch S3 is closed. This feature prevents firing of the wing stores while the turret is pointed at any position other than 0° azimuth. The burst limit feature is controlled by the burst limit relay in the aircraft. This relay is energized when the selected trigger is depressed to the second detent. Contacts on that relay open and disconnect the burst limit signal from the input to the gun control unit. When the PLT ORIDE switch on the gunner control panel is placed in the ON position, the gunner has an armed turret system which he can position with his helmet sight. The action and trigger switches, when in this mode, are located on the gunners cyclic stick. The TOW system is interlocked to off while in this mode.

e. *Turret Positioning.* The turret is positioned by a directional cosine servo system. The positioning of the turret system, other than gunner stow and fixed, is initiated by the sighting mechanism. The positioning block consists of the following functional groups: resolvers located in the sights, interface control unit, turret, servo amplifiers and motors, and emergency stow unit. The turret position resolvers are mechanically coupled to the turret saddle (elevation) and lower support assembly (azimuth). The servo amplifier consists of el and az servo amplifier circuits and servo motors, power amplifiers, and dc tachometer feedback loops. The emergency stow unit consists of an elevation and azimuth drive and a turret power amplifier cutoff signal. The el and az stow switches are mounted on the turret system and are mechanically actuated. The turret commanded position is dependent upon the position of the WPN CONTR switch. With the WPN CONTR switch set to FIXED the turret will slew to the fixed forward position (0° az, 0° el). In the FIXED position the fixed relay A6A1K1 is energized inhibiting the action relays A6A1K3, K4, and K5. With the action relays deenergized, the sine of el turret resolver signal and the sine of turret az resolver signal are applied to elevation and azimuth servo amplifiers respectively. These signals cause the amplifiers to drive the turret to null those resolver signals at approximately 0° el and 0° az. Thus, whenever the fixed relay A6A1K1 is energized, the turret will position to 0° el, 0° az. When the WPN CONTR switch is set to GUNNER position, fixed relay A6A1K1 is deenergized. With relay A6A1K1 deenergized, the upper stow signal is applied to the el servo amplifier causing the turret to drive to up 11° el (gunner stow). With the WPN CONTR switch set to GUNNER the action relays are enabled and the turret can be commanded by the selected sighting mechanism.

(1) Positioning the turret to a point of conversion consists of three steps: activating the turret system; acquiring the target with the selected sighting mechanism; and tracking the turret to a point of conversion. To activate the turret system, the action switch is depressed. With the action switch depressed, 28 Vdc is applied to action relays A6A1K3, K4, and K5. Relay A6A1K4, when energized applies the az error from the interface control unit to the variable main amplifier in the turret control assembly, and relay A6A1K5 provides a path for the el error signal to the el servo amplifier from the logic control. With the action relays energized, the servo drive circuits are enabled and the positioning resolver applies the proper signals to position the turret to a point of conversion. Acquisition of a target with a sighting mechanism can also be accomplished prior to closing the action relays. As a sight is moved in azimuth and elevation, the relative positions of the rotors of the sight resolvers are rotationally displaced from their respective stators. This displacement generates error signals which are applied to the appropriate servo amplifier. The servo amplifier then causes the turret to move in the direction to null the error. The nulling of the error is accomplished by the turret signals which excite the sight resolvers changing phase and amplitude according to turret position. The angle to which the sight was moved is thus duplicated by the turret. The elevation error signal is applied to the turret control through depression limit circuitry in the logic control. When the depression limit switch on the gunner control panel is in the TURRET DEPR LIMIT position, 28 Vdc is applied through the deenergized fixed relay to the logic control. Turret movement is then limited to -5° in downward movement to prevent driving barrels into the ground.

(2) When the turret is in the FIXED mode, the prime error signal is from the sine winding of the respective turret resolver. Therefore if the turret is not at zero, an error signal will be developed to move the turret to zero. A secondary input is available to the servo; it is the stow offset signal. This signal has a maximum position control of ±2 degrees. This allows boresighting

in the fixed mode without adjustment of the turret resolvers. Adjustment of stow offset potentiometers in the turret control will align the turret. In the gunner stow mode a fixed elevation stow voltage is equivalent to +11 degrees, and the azimuth stow input is shorted to ground.

(3) The az and el servo amplifiers are functionally similar. The az servo amplifier determines, by error signal phase, the direction in which the turret will be driven. As the turret moves, a tach feedback signal is developed and applied to the az servo amplifier. Both tach feedback signals, el and az, perform two functions. One is slew velocity limiting to keep the turret from driving too fast, and the second is a reverse drive signal provided to the servo amplifier when the turret position is within 4.5 degrees of the point of conversion. This provides a damping effect and stops the turret from overdriving the point of conversion and also prevents oscillation of the turret. When the turret reaches the point of conversion, both error signals are at zero volt level and the turret stops driving. When the turret stops driving, the tach feedback signal drops to zero volt level. As long as the sights are not moved, the turret will remain in that position. When the action switches are released, the action relays are deenergized and gunner stow positioning signals are applied to el and az servo amplifiers, returning the turret to gunner stow position. The limit switches (left, right, up and down) are mounted on the turret to provide safe positioning of the turret. When the turret is slewed into a limit switch, a signal is applied to the gun control prohibiting the gun from firing and to the applicable servo amplifier to prohibit the drive circuit from continuing to drive in that direction. Whenever the turret lags the sight command by more than 1.5° the logic control provides a coincidence signal to the gun control prohibiting gun firing.

(4) The emergency stow control provides the capability to stow the turret in emergency stow position (approximate gunner stow). The emergency stow control also provides the system the capability to stow safely when power to, or within, the system is low or faulty. The emergency stow control has a fixed position for stowing the system. When emergency stow is initiated, the system will drive to at least 10° up in elevation and to approximately 0° in azimuth. The el stow switch is a two-position switch. When all the electrical power required for system operation is applied to the system, the 28 Vdc power for the stow switches is inhibited. When one or more of the monitored power supplies are faulty, the following events occur: el and az brake power are routed via the respective stow switches; the turret control circuits are inhibited; and the el stow circuit supplies power to the elevation drive motor, driving the turret to upper stow position. When the turret achieves upper stow position, the el stow switch is activated, inhibiting power for the elevation drive and brake. This locks the turret in elevation stow position. When the el stow switch is activated, the 28 Vdc emergency stow power is routed through the az stow switch to the az brake enabling the az drive in the emergency stow control to position the turret to 0° azimuth. The az stow switch is a three-deck cam switch. One switch is open when the turret is out of the 0° azimuth position. The other two switches are open or closed depending on which side (left or right) of 0° azimuth the turret is positioned. If the turret is slewed left of 0°, the emergency stow control will cause the turret to slew right to 0° and stop. At this time the az brake power is inhibited, locking the turret in azimuth. When the turret is not in 0° azimuth, az stow switch S3 is opened to inhibit wing stores from firing. This switch is a safety switch to prevent damage to the turret system.

(5) The logic control coincidence circuits monitor either the gunner helmet sight system, pilot helmet sight system, or telescopic sight unit resolver signals. This provides to the gun control indications that the turret is aligned to sight and that the total resolver system is functional. Gun firing will be interrupted if coincidence between the sighting mechanisms and turret resolvers exceed 90° or resolver failure occurs. Also provided is a +18 Vdc interlock (these voltages are from the IFCU). A failure of either voltage will open the "Q" inputs to coincidence circuits.

(6) **E** Corrections are made to turret position to compensate for effects of air speed and target range. These signals are coupled into the resolver chain through the IFCU.

M The fire control computer provides continuous gun directing command signals proportional to the ballistic prediction angle, including compensation for effects of range, air density, helicopter pitch and roll, total velocity, rotor downward, weather vaning and time of flight. The computer provides inputs for compensation or alignment to the servo loop through the IFCU buffers. The computer inputs are parallel to the loop. In the event of computer failure, the IFCU bypasses the computer and ties the sights directly to the weapon connections.

f. *Weapon Control.* The gun is controlled by four functional groups: trigger logic, fire volts, gun drive motor circuits, and feeder and booster drive circuits. The trigger logic circuits consist of a burst limit circuit, rocket lockout circuit, reticle flasher circuit, and trigger enable gates circuitry. The trigger logic circuitry provides the safe-to-fire logic and will prohibit the turret system from firing when specified conditions are not met. The fire volts circuitry consists of fire volts time delay, fire volts lockout gates, fire volts power supply, and fire volts sensor circuit. The fire volts circuitry provides 320 Vdc to electrically fire the primer of the rounds, interrupt the fire volts when certain conditions are not met, and provide the logic control unit torque command circuitry a signal

which interlocks the torque command to the aircrafts SCAS system. The gun drive delay relay (gun drive motor) circuit provides a delay for gun clearing. The feeder and booster drive circuit consists of a relay driver which energizes the feeder solenoid and booster motor.

(1) The trigger logic circuits consist of six AND gates, a rocket lockout time delay, a burst limiter circuit, and a reticle flasher circuit. The six AND gates receive their inputs from the four turret limit switches and turret positioning el and az coincidence signals. When the turret system activates any turret limit switch the trigger signal is interrupted and a system that is firing goes into clearing. When the turret system slews out of that limit, the trigger signal is again enabled and the gun again starts firing. The el and/or az error signals occur when one of the sights position command leads the actual position turret by 1.5° or resolver failure occurs. When this occurs, the trigger signal is inhibited and the gun goes into a non-firing clearing cycle. When the turret position catches up with the sight commanded position (less than 1.5°), the gun will resume firing. When the turret system is in a firing condition, the sight reticle lamp is constantly illuminated. When the trigger signal is interrupted, a trigger lockout signal is applied to the reticle flasher circuit. This causes the sight reticle lamp to blink on and off, indicating the gun firing circuits are inhibited. When the gun is again enabled, the reticle lamp stops flashing.

(2) With trigger applied and interlock conditions good, the trigger signal is applied to fire volts time delay, feeder/booster relay driver, and to gun motor time delay circuits. The time delays (fire volts and gun motor) are activated upon the release of the trigger or when the trigger signal is interrupted. Fire volts time delay and fire volts lockout route the trigger signal to fire volts relay. With this signal applied, the fire volts relay is energized and 320 Vdc is applied to the gun. The volts sensor circuit samples the fire volts and each time a round is fired, the voltage level drops, providing a pulse. The sensor circuit detects the pulse and applies a signal to the logic control assembly indicating the gun is firing. The gun time delay energizes the gun motor relay K5. With K5 energized, 28 Vdc is applied to the gun motor and the gun starts to rotate. Also energized at this time is the feeder and booster motor, supplying rounds to the gun. As the booster motor turns, a rounds count pulse from a proximity sensor is applied to the rounds remaining indicator (located on the gunner control panel) and to the rounds totalizer (located on the turret). A sprocket for each round that passes through the booster is used for the activations of the proximity sensor. Upon release of the trigger, the gun control circuitry initiates the clearing cycle. The fire volts time delay enables fire volts to be applied for approximately 1.5 seconds after trigger is released. Gun motor time delay enables the barrel cluster to rotate approximately 650 milliseconds after trigger release. The feeder and booster motor relays are deenergized upon release of the trigger, inhibiting rounds from being fed to the gun. With the gun driving for approximately 650 milliseconds after feeder is deenergized, any rounds remaining in the gun (approximately two to four) will be fired out. When the trigger switch is depressed to the 1st detent these same events will occur after 16 ±4 rounds have been fired. The burst limit circuit causes the trigger logic circuit to inhibit the trigger signal 1.5 seconds (approximately) after trigger is pressed. This causes the turret system to fire about 16 ±4 rounds, including clearing. The rocket lockout signal can only be applied with the turret system in the azimuth stow position. With rocket lockout signal applied, the lockout time delay inhibits the trigger signal. When rocket lockout signal is removed, the lockout time delay inhibits the trigger signal for approximately 1 ±0.5 seconds to ensure safe firing of wing stores.

Section IV. MAINTENANCE OF TURRET SYSTEM

3-11. Checkout of Emergency Stow Control (ESCU). The emergency stow control may be checked out while mounted within the turret structure.

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however, inadvertent movement of turret from cockpit could injure personnel.

a. On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to OFF (pulled), set TURRET CONTR E ARMT CONTR M circuit breaker to OFF (down), and set TURRET PWR circuit breaker to OFF (pulled).
b. Erect a safety barricade on perimeter of turret system.
c. Disconnect all turret cable connectors from emergency stow control.
d. Position test set on left-hand ammo bay door.
e. Connect test set cable W1 as follows:
 W1P1 to test set J1.
 W1P2 to aircraft power receptacle 19J2.
f. Connect test set extender cables W2 and W4 as follows:
 W2P1 to test set J4
 W4P1 to test set J3
g. Connect test set cable W10 as follows:
 W10P1 to extender cable W2P2
 W10P2 to extender cable W4P2
 W10P3 to emergency stow control J1
 W10P4 to emergency stow control J2
 W10P5 to emergency stow control J3
h. Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
 BATTERY to RUN
 NON-ESNTL BUS to MANUAL
 ELEC PWR/EMER OFF to ELEC PWR
i. Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC power lamps should illuminate. If not, check power to aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.
j. Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically begins a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 indication in the CODE display. Observe that these three conditions are present, then proceed.
k. Press the RUN pushbutton. The REFERENCE display should now display 6000 and the CODE display should remain at 88. These two displays verify that cable W10 is properly connected between the test set and the unit under test.
l. Enter A0 in the test set by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.
m. Press the RUN pushbutton. This initiates the automatic test sequence for the emergency stow control. Upon completion of the automatic sequence either the PASS or the FAIL indicator lamp will illuminate.

NOTE

Electrical repair of the emergency stow control is not authorized at the AVUM level.

n. If the PASS indicator illuminates, the UUT is good. If the FAIL indicator illuminates, the UUT requires repair. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC

PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return emergency stow control to service if good or send to next higher maintenance level for repair.

o. Deleted.

3-12. Checkout of Gun Control (GCU). The gun control may be checked out while mounted on the aircraft.

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

a. On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR E ARMT CONTR M circuit breaker to off (down), and set TURRET PWR circuit breaker to off (pulled).
b. Erect a safety barricade on perimeter of turret system.
c. Disconnect all turret cable connectors from gun control.
d. Position test set on right-hand ammo bay door.
e. Connect test set cable W1 as follows:
W1P1 to test set J1
W1P2 to aircraft power receptacle 19J2.
f. Connect test set extender cables W2 and W4 as follows:
W2P1 to test set J4
W4P1 to test set J3
g. Connect test set cable W9 as follows:
W9P6 to extender cable W2P2
W9P5 to extender cable W4P2
W9P3 to gun control J1
W9P4 to gun control J2
W9P2 to test set J3
W9P1 to test set J4
W9P7 to test set J6
h. Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN
NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR
i. Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC power lamps should illuminate. If not, check power to aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.
j. Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically begins a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 indication in the CODE display. Observe that these three conditions are present, then proceed.
k. Press the RUN pushbutton. The REFERENCE display should now display 4000 and the CODE display should remain at 88. These two displays verify that cable W9 is properly connected between the test set and the unit under test.
l. Enter A0 in the test set by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.
m. Press the RUN pushbutton. This initiates the automatic test sequence for the gun control. Upon completion of the automatic sequence either the PASS or the FAIL indicator lamp will illuminate.

NOTE

Electrical repair of the gun control is not authorized at the AVUM level.

n. If the PASS indicator illuminates, the UUT is good. If the FAIL indicator illuminates, the UUT requires repair. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY

power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return gun control to service if good or send to next higher maintenance level for repair.

o. Deleted.

3-13. Checkout of Turret Control (TCU). The turret control may be checked out while mounted on the aircraft.

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however, inadvertent movement of turret from cockpit could injure personnel.

a. On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR E ARMT CONTR M circuit breaker to off (down), and set TURRET PWR circuit breaker to off (pulled).
b. Erect a safety barricade on perimeter of turret system.
c. Disconnect all turret cable connectors/terminal lugs from turret control.
d. Position test set on right-hand ammo bay door.
e. Connect test set cable W1 as follows:
W1P1 to test set J1
W1P2 to aircraft power receptacle 19J2
f. Connect test set extender cables W2 and W4 as follows:
W2P1 to test set J4
W4P1 to test set J3
g. Connect test set cable W8 as follows:
W8P1 to extender cable W2P2
W8P3 to extender cable W4P2
W8P4 to turret control J1
W8P5 to turret control J2
W8P2 to turret control J3
W8J1 to turret control P1
W8E1 to turret control E1
W8E2 to turret control E2
h. Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN
NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR
i. Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC power lamps should illuminate. If not, check power to aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.
j. Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically begins a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 indication in the CODE display. Observe that these conditions are present, then proceed.
k. Press the RUN pushbutton. The REFERENCE display should now display 3000 and the CODE display should remain at 88. These two displays verify that cable W8 is properly connected between the test set and the unit under test.
l. Enter A0 in the test set by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.
m. Press the RUN pushbutton. This initiates the automatic test sequence for the turret control. Upon completion of the automatic sequence either the PASS or the FAIL indicator lamp will illuminate.

NOTE

Electrical repair of the turret control is not authorized at the AVUM level.

n. If the PASS indicator illuminates, the UUT is good. If the FAIL indicator illuminates, the UUT requires repair. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV

circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return turret control to service if good or send to next higher maintenance level for repair.

o. Deleted.

3-14. Checkout of Logic Control (LCU). The logic control may be checked out while mounted on the aircraft.

WARNING

Make sure a barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

a. On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR E ARMT CONTR M circuit breaker to off (down), and set TURRET PWR circuit breaker to off (pulled).
b. Erect a safety barricade on perimeter of turret system.
c. Disconnect all turret cable connectors from logic control.
d. Position test set on left-hand ammo bay door.
e. Connect test set cable W1 as follows:
W1P1 to test set J1
W1P2 to aircraft power receptacle 19J2.
f. Connect test set extender cables W2 and W4 as follows:
W2P1 to test set J4
W4P1 to test set J3
g. Connect test set cable W14 as follows:
W14P1 to extender cable W2P2
W14P2 to extender cable W4P2
W14P3 to logic control J1
W14P4 to logic control J2
W14P5 to logic control J3
h. Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN
NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR
i. Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC power lamps should illuminate. If not, check power to aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.
j. Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically begins a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 indication in the CODE display. Observe that these three conditions are present, then proceed.
k. Press the RUN pushbutton. The REFERENCE display should now display 5000 and the CODE display should remain at 88. These two displays verify that cable W14 is properly connected between the test set and the unit under test.
l. Verify that the weapon select switch, located on side of unit under test is locked in 20-mm position.
m. Enter A0 in the test set by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.
n. Press the RUN pushbutton. This initiates the automatic test sequence for the logic control. Upon completion of automatic sequence either the PASS or the FAIL indicator lamp will illuminate. If PASS is indicated proceed to step r.; if FAIL is indicated proceed to step s.
o. Deleted.
p. Deleted.
q. Deleted.

r. Check torque command function of unit under test as follows:
 (1) Enter C0 on keyboard and depress RUN pushbutton. Verify that 9993 appears in REFERENCE display and C0 appears in CODE display.
 (2) Enter 32 on keyboard and depress RUN pushbutton. Verify that REFERENCE display indicates approximately 0 (Vdc) and the CODE display indicates 32. If indication is abnormal, A2 module is defective, replace UUT.
 (3) Enter C1 on keyboard and depress RUN pushbutton. Verify that 9993 appears in REFERENCE display and C1 appears in CODE display.
 (4) Enter 32 on keyboard and depress RUN pushbutton. Verify that REFERENCE display indicates 26 ±4 (Vdc) and the CODE display indicates 32. If indication is abnormal, A2 module is defective, replace UUT.
 (5) If indications in steps (2) and (4) are good, then checkout of unit under test is complete. The unit under test is good. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return logic control to service.

NOTE

Repair of the logic control unit is not authorized at the AVUM level.

s. If the FAIL indicator illuminates the unit under test requires repair. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Send logic control to next higher maintenance level for repair.

3-15. Checkout of Interface Control Unit (IFCU). The interface control unit may be checked out while mounted on the aircraft.

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

a. On aircraft circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR **E** ARMT CONTR **M** CIRCUIT BREAKER to OFF (down), and set TURRET PWR circuit breaker to OFF (pulled).
b. Erect a safety barricade on perimeter of turret system.
c. Disconnect all aircraft cable connectors from interface control unit.
d. Position test set on left-hand ammo bay door.
e. Connect test set cable W1 as follows:
 W1P1 to test set J1
 W1P2 to aircraft power receptacle 19J2
f. Connect test set extender cables W2, W3, and W4 as follows:
 W2P1 to test set J4
 W3P1 to test set J5
 W4P1 to test set J3
g. **E** Connect test set cable W7 as follows:
 W7P1 to extender cable W2P2
 W7P2 to extender cable W3P2
 W7P3 to extender cable W4P2
 W7P4 to IFCU J311
 W7P5 to IFCU J312
 W7P6 to IFCU J313
 M Connect test set cable W20 as follows:
 W20P1 to extender cable W2P2
 W20P2 to extender cable W3P2
 W20P3 to extender cable W4P2
 W20P4 to IFCU J13
 W20P5 to IFCU J14
 W20P5 to IFCU J15
h. Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft

armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN
NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR

i. Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC lamps should illuminate. If not, check power to aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.

j. Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically begins a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 indication in the CODE display. Observe that these three conditions are present, then proceed.

k. Press the RUN pushbutton. The REFERENCE display should now display 2000 E +2000 M and the CODE display should remain at 88. These two displays verify that cable W7 E W20 M is properly connected between the test set and the unit under test.

l. Enter A0 in the test set by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.

m. Press the RUN pushbutton. This initiates the automatic test sequence for the interface control unit. Upon completion of the automatic sequence either the PASS or the FAIL indicator lamp will illuminate.

NOTE

Electrical repair of the interface control unit is not authorized at the AVUM level.

n. If the PASS indicator illuminates, the UUT is good. If the FAIL indicator illuminates, the UUT requires repair. Set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return interface control unit to service if good or send to next higher maintenance level for repair.

o. Deleted.

3-16. Checkout of Gunner Control Panel (GCP).

a. The following procedures are for AVUM checkout of the gunner control panel. The automatic test of the gunner control panel is divided into three parts. It is necessary to divide the procedure into three parts in order to assure that all possible combinations of control panel switches are manually positioned and are functional. Prior to each part of the automatic check it is required that the control panel switches be manually positioned to specified positions. After the switch positioning is made, the appropriate test set keyboard entry is made and the RUN pushbutton is depressed. The first part of the automatic test will then be completed by the test set. If a PASS indication is displayed by the test set, the control panel switches are manually positioned to another specified set of positions, a second keyboard entry is made and the RUN pushbutton is again depressed. This is repeated until the three-part automatic test is completed.

b. If a FAIL indicator light is displayed at the completion of either part of the automatic test, then the REFERENCE display will contain a 4-digit fault code. The fault codes are used by the next higher level of maintenance for troubleshooting and corrective action. All corrective actions must be made at a higher level of maintenance since repairs at the AVUM level are not authorized on the gunner control panel. If a FAIL indication occurs in any part of the automatic test, you should not proceed with the succeeding parts. This is because each succeeding part of the automatic test assumes successful completion of the preceding parts. Otherwise, any uncorrected failures early in the check could cause a snowballing of failures in the remaining checks. Forward the control panel to the next higher maintenance level upon getting a FAIL indicator at any point in the test.

c. The control panel can be tested by AVUM at the aircraft, using aircraft power for the test set. The control panel must be disconnected from the aircraft cable and then removed to a position outside the aircraft. The left ammo bay door will be the most convenient place for locating both the control panel and test set.

d. Proceed with the test as follows:

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

(1) On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR E ARMT CONTR M circuit breaker to off (down), and set TURRET PWR circuit breaker to off (pulled).

(1.1) Erect a safety barricade on perimeter of turret system.

(1.2) Disconnect all turret cable connectors from gunner control panel.

(1.3) Connect test set cable W1 as follows:
W1P1 to test set J1
W1P2 to aircraft power receptacle 19J2

(2) E Connect test set cable W11 as follows:
W11P1 to test set J5
W11P2 to UUT 22A3J1
M Connect test set cable W22 as follows:
W22P1 to test set J5
W22P2 to UUT

(3) Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN
NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR

(4) Apply power to test set by placing both test set POWER switches to the ON position. The AC and DC power lamps should illuminate. If not, check power to the aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.

(5) Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically performs a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp; (2) an 8888 indication in the REFERENCE display; and (3) an 88 in the CODE display. Observe that these three indications are present, then proceed.

(6) Press the RUN pushbutton. The REFERENCE display should now display 7000 E +7000 M and the CODE display should remain at 88. These displays verify that cable W11 E W22 M is properly connected between test set and unit under test.

(7) Perform the first part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated.
PLT ORIDE to OFF
RANGE to SHORT
WING STORE to RKT
HSS BIT to OFF
HSS RTCL INTENSITY to OFF (Fully CCW)
HSS RTCL/TEST to OFF (not depressed)
E A/S COMPEN to OFF
E SLEW RATE to NORM
E TURRET DEPR LIMIT to OFF
M TUR SLEW to NORM
M LASER SAFE/TURRET DEPR LIMIT to OFF
M TSU/GUN SLEW RATE to HIGH

(b) Enter A0 by keyboard entry. A proper entry is acknowledged by A0 appearing in the CODE display.

(c) Press the RUN pushbutton. This initiates the first part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate. If the PASS indicator illuminates,

proceed to step (8) for the second part of the automatic test. If the FAIL indicator illuminates forward the unit under test to next higher maintenance level for repair.

(8) Perform the second part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated:
PLT ORIDE to ORIDE
RANGE to MED
WING STORE to GUN
HSS RTCL Intensity (ON, but not rotated to BRT)
HSS RTCL/TEST to OFF (not depressed)
HSS BIT (hold ON during test)
E A/S COMPEN to COMPEN
E SLEW RATE to SLOW
E TURRET DEPR LIMIT to ON
M TUR SLEW to GRD TEST
M LASER SAFE/TURRET DEPR LIMIT to ON
M TSU/GUN SLEW RATE to LOW

(b) Enter A1 by keyboard entry. A proper entry is acknowledged by A1 appearing on the CODE display.

(c) With HSS BIT on unit under test held on, press the test set RUN pushbutton. This initiates the second part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate. If the PASS indicator illuminates, proceed to step (9) for the third part of the automatic test. If the FAIL indicator illuminates, forward the unit under test to next higher maintenance level for repair.

(9) Perform the third part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated:
RANGE to LONG
RD RMNG counter, enter 750
HSS BIT (hold depressed during test)
HSS RTCL/TEST (hold depressed during test)

(b) Enter A2 by keyboard entry. A proper entry is acknowledged by A2 appearing on the CODE display.

(c) With both the HSS RTCL/TEST pushbutton and HSS BIT indicator on unit under test held depressed, press the test set RUN pushbutton. This initiates the third part of the automatic test sequence. Upon completion of the automatic test sequence, either the PASS or FAIL indicator lamp will illuminate. Also, the operator shall verify that 50 less rounds show on the RD RMNG indicator.

(d) If the PASS indicator illuminates, proceed to step (10).

(e) If the FAIL indicator illuminates or the RD RMNG indicator did not indicate 50 less rounds, forward the unit under test to next higher maintenance level for repair.

(f) Proceed to step (10) for manual checks.

(10) Perform the following manual checks on the unit under test.

(a) Enter C0 on test set keyboard and press the RUN pushbutton. The test set is now applying 28 Vdc to all indicator lamps. Note that all lights are on bright.

(b) Enter C1 in test set keyboard and press the RUN pushbutton. The test set is now applying 28 Vdc to all indicator lamps, and 28 Vdc across relay assembly (8Z3) coil. Note that STBY/ARMED and PILOT IN CONT lights noticeably dim. If they do not, relay assembly (8Z3) is defective; forward unit under test to next higher maintenance level for repair.

(c) Enter C0 on test set keyboard and press the RUN pushbutton. Now enter 66 on keyboard and press RUN pushbutton. On unit under test, rotate HSS RTCL intensity knob between OFF and BRT while observing REFERENCE display. The voltage readings should vary with movement of knob. If there is no variation in reading, forward unit under test to next higher maintenance level for repair.

(d) In either C0 or C1 mode the test set applied 28 Vdc to unit under test J1-Z. Note that both light transmitting panels are functional by diffusion of light through the panel lettering. If either panel is not lighted, forward unit under test to next higher maintenance level for repair.

(11) Upon completion of all checks set test set POWER switches to OFF, aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return unit under test to service if all tests passed, or to the next higher maintenance level if any test failed.

3-17. Checkout of Pilot Control Panel (PCP).

a. The following procedures are for AVUM checkout of the pilot control panel. The automatic test of the pilot control panel is divided into four parts. It is necessary to divide the procedure into four parts in order to assure that all possible combinations of control panel switches are manually positioned and are functional. Prior to each part of the automatic check it is required that the control panel switches be manually positioned to specified positions. After the switch positioning is made, the appropriate test set keyboard entry is made and the RUN pushbutton is depressed. The first part of the automatic test will then be completed by the test set. If a PASS indication is displayed by the test set, the control panel switches are manually positioned to another specified set of positions, a second keyboard entry is made and the RUN pushbutton is again depressed. This is repeated until the four-part automatic test is completed.

b. If a FAIL indicator light is displayed at the completion of either part of the automatic test, the REFERENCE display will contain a 4-digit fault code. The fault codes are used by next higher maintenance level for troubleshooting and corrective action. All corrective actions must be made at a higher maintenance level since repairs at the AVUM level are not authorized on the pilot armament control panel. If a FAIL indication occurs in any part of the automatic test you should not proceed with the succeeding parts. This is because each succeeding part of the automatic test assumes successful completion of the preceding parts. Therefore, any uncorrected failures early in the check could cause a snowballing of failures in the remaining checks. Forward the control panel to the next higher maintenance level upon getting a FAIL indication at any point in the test.

c. The control panel can be tested by AVUM at the aircraft, using aircraft power for the test set. The control panel must be disconnected from the aircraft cable and then removed to a position outside the aircraft. The left ammo bay door will be the most convenient place for locating both the control panel and test set.

d. Proceed with the test as follows:

WARNING

Make sure a safety barricade surrounds turret working area (area swept by gun barrels) at all times. Make sure that TURRET DRIVE MOTOR circuit breaker on aircraft armament circuit breaker panel is pulled OUT at all times to prevent accidental movement of turret. This test does not require turret operation; however inadvertent movement of turret from cockpit could injure personnel.

(1) On aircraft armament circuit breaker panel set TURRET DRIVE MOTOR circuit breaker to off (pulled), set TURRET CONTR **E** ARMT CONTR **M** circuit breaker to off (down), and set TURRET PWR circuit breaker to off (pulled).

(1.1) Erect a safety barricade on perimeter of turret system.

(1.2) Disconnect all turret cable connectors from pilot control panel.

(1.3) Connect test set cable W1 as follows:
W1P1 to test set J1
W1P2 to aircraft power receptacle 19J2

(2) **E** Connect test set cable W12 as follows:
W12P1 to test set J5
W12P2 to UUT 22A2J1
M Connect test set cable W23 as follows:
W23P1 to test set J5
W23P2 to UUT 22A2J1

(3) Connect 28 Vdc to aircraft in accordance with TM 55-1520-236/239-23. On aircraft armament circuit breaker panel set WPN CONTR circuit breaker to WPN CONTR. On DC circuit breaker panel set INV circuit breaker to ON (pushed) and place the following power switches to the positions indicated:
BATTERY to RUN

NON-ESNTL BUS to MANUAL
ELEC PWR/EMER OFF to ELEC PWR

(4) Apply power to test set by placing both test set POWER switches in the ON position. The AC and DC power lamps should illuminate. If not, check power to the aircraft power receptacle 19J2 through aircraft circuit breakers 19CB1 and 19CB4.

(5) Upon application of power (indicated by AC and DC power lights illuminated) the test set automatically performs a self-test requiring approximately 5 seconds. The self-test ensures that the test set is ready to begin its automatic test sequence. Successful completion of the self-test is indicated by: (1) an illuminated PASS lamp: (2) an 8888 indication in the REFERENCE display; and (3) an 88 in the CODE display. Observe that these three indications are present, then proceed.

(6) Press the RUN pushbutton. The REFERENCE display should now display 8000 E +8000 M and the CODE display should remain at 88. These displays verify that cable W12 E W23 M is properly connected between test set and unit under test.

(7) Perform the first part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated.
WPN CONTR to FIXED
MASTER ARM to OFF
RECOIL COMPEN to OFF
RANGE to SHORT
WING STORE to RKT
HSS RTCL Intensity to OFF (fully CCW)
HSS RTCL/TEST to OFF (not depressed)

(b) Enter A0 by keyboard entry. A proper entry is acknowledged by A0 appearing on the CODE display.

(c) Press the RUN pushbutton. This initiates the first part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate. If the PASS indicator illuminates, proceed to step (8) for the second part of the automatic test. If the FAIL indicator illuminates, forward the unit under test to next higher maintenance level for repair.

(8) Perform the second part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated:
WPN CONTR to GUNNER
MASTER ARM to STBY
RECOIL COMPEN to COMPEN
RANGE to SHORT
WING STORE to GUN
HSS RTCL Intensity (ON, but not rotated to BRT)
HSS RTCL/TEST to OFF (not depressed)

(b) Enter A1 by keyboard entry. A proper entry is acknowledged by A1 appearing on the CODE Display.

(c) Press the RUN pushbutton. This initiates the second part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate. If the PASS indicator illuminates, proceed to step (9) for the third part of the automatic test. If the FAIL indicator illuminates, forward the unit under test to next higher level of maintenance for repair.

(9) Perform the third part of the automatic test as follows:

(a) Manually position the following switches on the unit under test to the positions indicated:
WPN CONTR to PILOT
MASTER ARM to ARM
RANGE to MED
HSS RTCL/TEST (hold depressed)

(b) Enter A2 by keyboard entry. A proper entry is acknowledged by A2 appearing on the CODE display.

(c) With the HSS RTCL TEST pushbutton on unit under test held depressed, press the test set RUN pushbutton. This initiates the third

part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate. If the PASS indicator illuminates, proceed to step (10) for the fourth and final part of the automatic test. If the FAIL indicator illuminates forward the unit under test to next higher maintenance level for repair.

(10) Perform the fourth part of the automatic test as follows:
 (a) Manually position the following switches on the unit under test to the positions indicated:
 MASTER ARM to STBY
 RANGE to LONG
 (b) Enter A3 by keyboard entry. A proper entry is acknowledged by A3 appearing on the CODE display.
 (c) Press the RUN pushbutton. This initiates the fourth part of the automatic test sequence. Upon completion of the automatic test sequence either the PASS or FAIL indicator lamp will illuminate.
 (d) If the PASS indicator illuminates, proceed to step (11).
 (e) If the FAIL indicator illuminates, forward the unit under test to the next higher maintenance level for repair.

(11) Perform the following manual checks on the unit under test.
 (a) On the unit under test, set the MASTER ARM switch to ARM.
 (b) On the test set, enter C0 on the keyboard and press the RUN pushbutton. The test set is now applying 28 Vdc to unit under test J1-A and -T, and an open at J1-S.
 Note that STBY and ARMED lights are illuminated. If not illuminated, then DS5 lamps and contacts, or relay assembly (8Z4) is defective. Forward unit under test to next higher maintenance level for repair.
 (c) With test set still in C0 mode, set MASTER ARM switch on unit under test to OFF. The STBY and ARMED lights should extinguish. If both lights do not extinguish, forward unit under test to next higher maintenance level for repair.
 (d) On the test set enter C1 on the keyboard and press the RUN pushbutton. The test set is now applying 28 Vdc to unit under test J1-A and -T, and a ground at J1-S. Note that STBY and ARMED lights noticeably dim. If they do not, relay assembly (8Z4) is defective. Forward unit under test to next higher maintenance level for repair.
 (e) In either C0 or C1 mode the test set applies 28 Vdc to unit under test J1-T. Note that light transmitting panel is functional by diffusion of light through the panel lettering. If panel is not illuminated, forward unit under test to next maintenance level for repair.

(12) Upon completion of all checks, set test set POWER switches to OFF, and aircraft WPN CONTR circuit breaker to OFF, INV circuit breaker to OFF (pulled), BATTERY power switch to OFF, and ELEC PWR/EMER OFF to EMER OFF. Disconnect test set cables. Return unit under test to service if all tests passed, or to next higher maintenance level if any test failed.

M 3-17.1. Checkout of Turret Buffer Amplifier. Refer to Tables 3-5 and/or 3-6.

CAUTION

When Fire Control Computer is in operation turret buffer amplifier bypass cable shall not be used.

a. When it is indicated that turret buffer amplifier should be checked, a known good unit or a bypass calbe, which eliminates the unit from the system, should be used and the test rerun.

b. If repair of turret buffer amplifier is required, it must be forwarded to a higher maintenance level.

M 3-17.2. Checkout of Logic Relay Assembly. Refer to Tables 3-5 and/or 3-6.

a. When it is indicated that logic relay assembly should be checked, a known good unit should be used and the test performed.

b. If repair of logic relay assembly is required, it must be forwarded to a higher maintenance level.

M 3-17.3. Checkout of Acquisition Switch Panel.

a. Make sure that aircraft power is off.

b. Remove switch from gunners instrument panel (paragraph 3-127).

c. Remove wires TG200E22 and TG200H22 from switch terminal 2 (fig. 3-2.2).

d. Perform continuity check at switch terminals with ACQ switch in positions as follows:

Switch Position	Terminal		Results
	From	To	
PHS	2	1 & 4	Continuity
M ALT	2	1 & 6	Continuity
NORM	2	1, 4 & 6	Open

e. Install wires on switch terminal 2 (fig. 3-2.2) and install acquisition switch on gunners' instrument panel (paragraph 3-130).

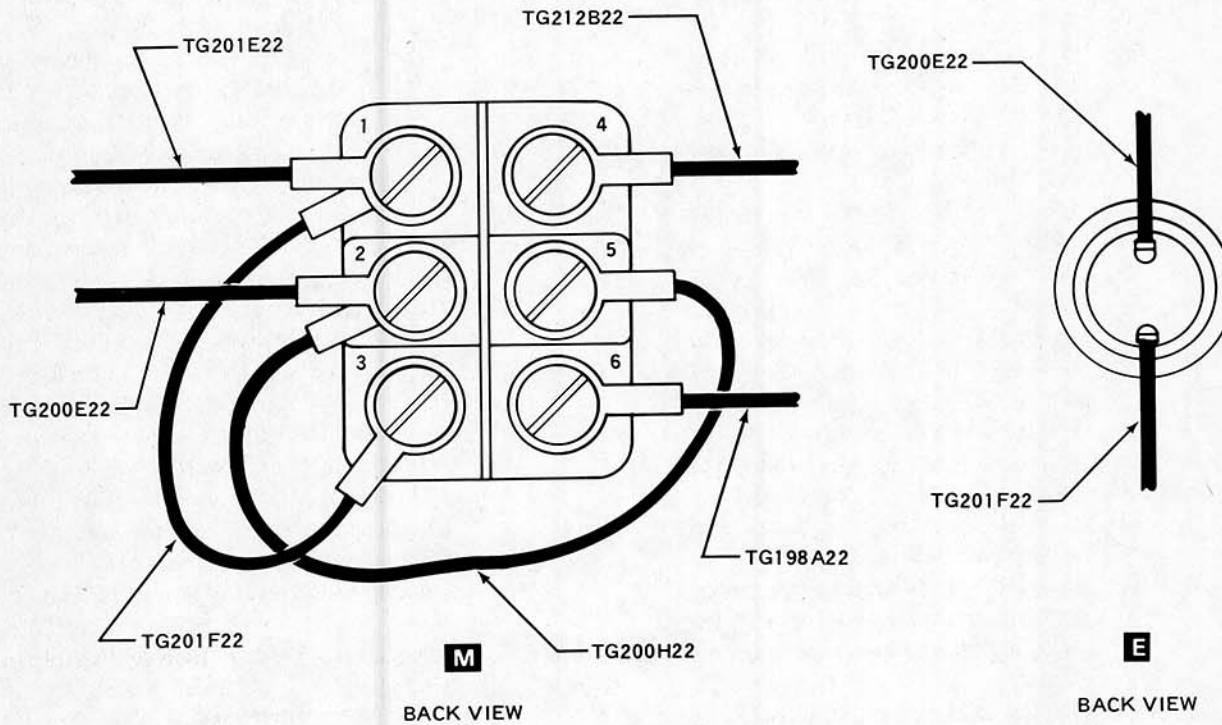


Figure. 3-2.2. Acquisition Switch Panel Terminals

Section V. MAINTENANCE OF M89E1 FEEDER

3-18. Description.

a. The M89E1 feeder, figure 1-2, is mounted on and geared to the M197 gun and is driven by the gun drive (11, fig. 3-3). The M89E1 feeder is secured with two mounting pins that are retained by two locks. The feed chute is fastened to the feeder chuting clips.

b. The primary parts of the M89E1 feeder are the forward and aft housing assemblies, the feeder sprocket assembly, accelerator sprocket assembly, the stripper sprocket assembly, T-bar guide assembly, and solenoid assembly. The housing assemblies provide attachment points for the M89E1 feeder. The stripper sprocket and fixed stripper strips the round from the link; moves it to the accelerator sprocket; then to the feeder sprocket assembly, which in turn feeds the M197 gun.

1. Spring
2. Azimuth drive
3. Pilot control panel
E 4. Reflex sight
5. Interface control unit
6. Logic control
7. Ammunition box
8. Feed chute
9. Pressure transducer
M 9.1. Logic relay assembly
M 9.2. Turret buffer amplifier
10. Gun control
11. Gun drive
12. Recoil adapter
13. M197 gun
14. M89E1 feeder
14.1. Link eject chute
14.2. Rounds sensing switch
15. Slider
16. Turret
17. Turret control
18. Gunner control panel
19. Azimuth resolver
20. Acquisition switch panel

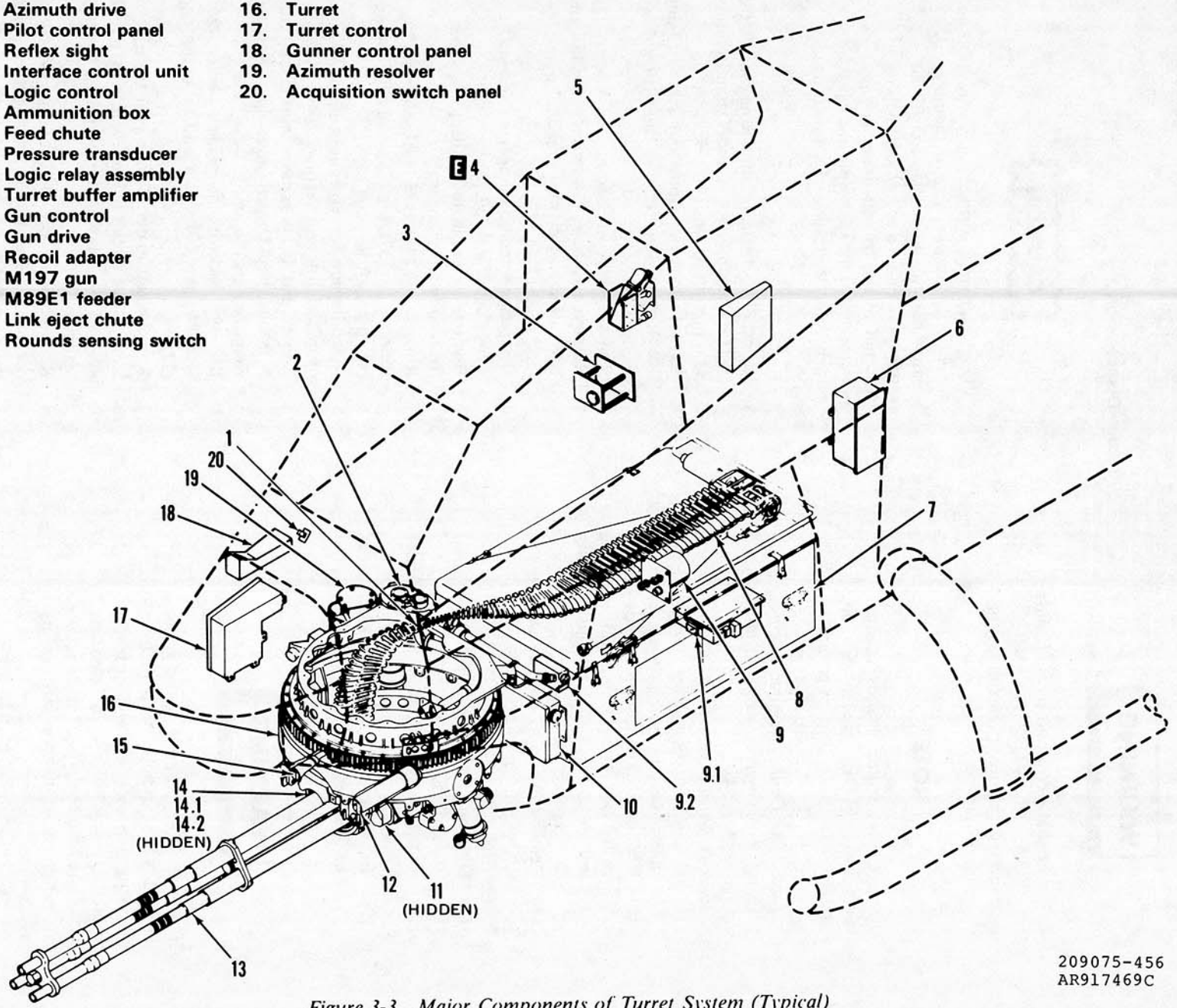


Figure 3-3. Major Components of Turret System (Typical)

3-19. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

NOTE

The link eject chute, rounds sensing switch, and M89E1 feeder can be removed individually or as a group.

a. *Link Eject Chute.* Remove link eject chute (2, fig. 3-4.1) by removing four bolts (3) and four washers (4).
b. *Rounds Sensing Switch.*
 (1) Disconnect connector W5P3 from rounds sensing switch (9, fig. 3-4.1).
 (2) Remove lockwire from rounds sensing switch (9) and bracket (6). Remove rounds sensing switch (9) and shim (10) from bracket (6).
 (3) Remove two bolts (8), two washers (7), spacer (5), and bracket (6).
c. *M89E1 Feeder.*
 (1) Disconnect connector W2P2 (fig. 3-4) from M89E1 feeder.
 (2) Remove feed chute from M89E1 feeder (fig. 3-5).
 (3) Break ammunition belt at M89E1 feeder (fig. 3-6).

WARNING

If gun and/or feeder is found to be jammed when attempting to perform following step, clear gun and/or feeder immediately. Follow a clearing procedure based on type of malfunction encountered. Observe all safety precautions.

 (4) Depress feeder solenoid plunger and rotate barrel cluster of gun until all rounds are cleared from M89E1 feeder.
 (5) Remove M89E1 feeder from gun by removing two feeder mounting pins (1, fig. 3-4.1).

3-20. Disassembly.

CAUTION

When removing spring pins, use a punch or drift pin with a diameter greater than the inside diameter of the spring pin. Failure to use a punch or drift pin of the correct diameter may peen the end of the spring pin and cause it to become wedged in the mounting hole.

a. If installed, disengage mounting pins (9, fig. 3-7) from pin locks (8 and 11) and remove two mounting pins (9).
b. Remove lockwire from four screws (7 and 10). Remove four screws (7 and 10) and two locks (8 and 11).
c. Remove lockwire from two bolts (3). Remove two bolts (3), two washers (2), and body of solenoid (4), using a 12-point 1/4-inch socket.
d. Disengage solenoid plunger with spring from wedge drive arm (39).
e. Remove cotter pin (6), washer (5), and pin (1) from solenoid plunger.
f. Remove pin (42), bolt (40), and arm (39).
g. Remove pin (37), pin (38), and clutch wedge (41) from aft housing (71).
h. Restrain gears from turning using a soft piece of material in gear teeth.
i. Loosen, but do not remove, nuts (51, 53, and 56). Nuts should be left finger-tight on shafts.
j. Remove nuts (34 and 36).
k. Remove lockwire from two bolts (26). Remove two bolts (26) and retaining cap (27).
l. Remove soft material from gear teeth.
m. Loosen five screws (25) a few turns at a time until all five screws are free from aft housing assembly.
n. Remove clutch lock (19), rotating vane (20), bearing (21), and gear (28) with attached parts from shaft of accelerator sprocket (65). Remove bearing (18) for replacement only.
o. Remove five screws (25) from retainer (24) located behind gear (28).

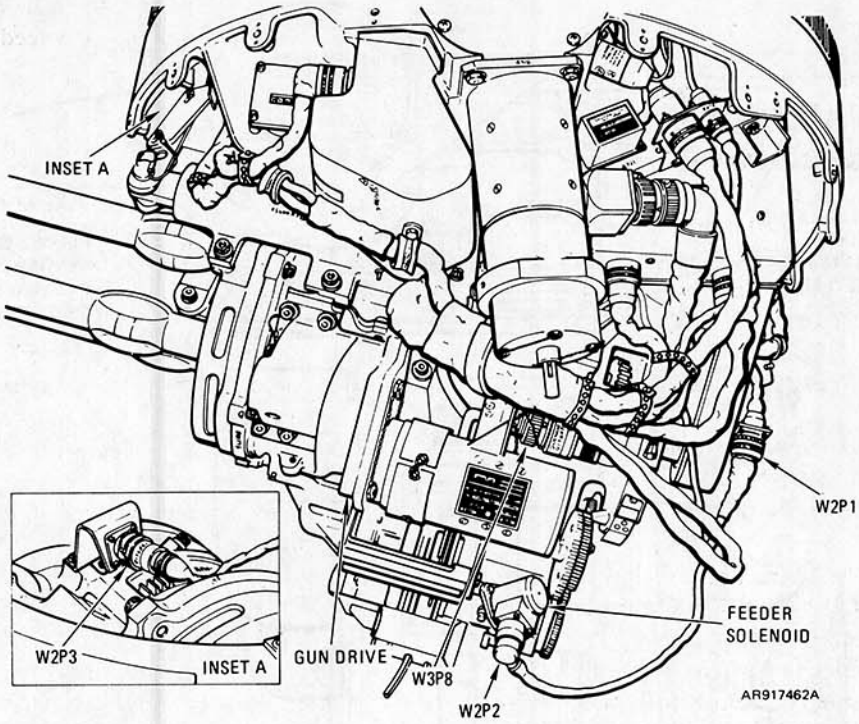


Figure 3-4. Gun, Gun Drive, and Feeder Connection

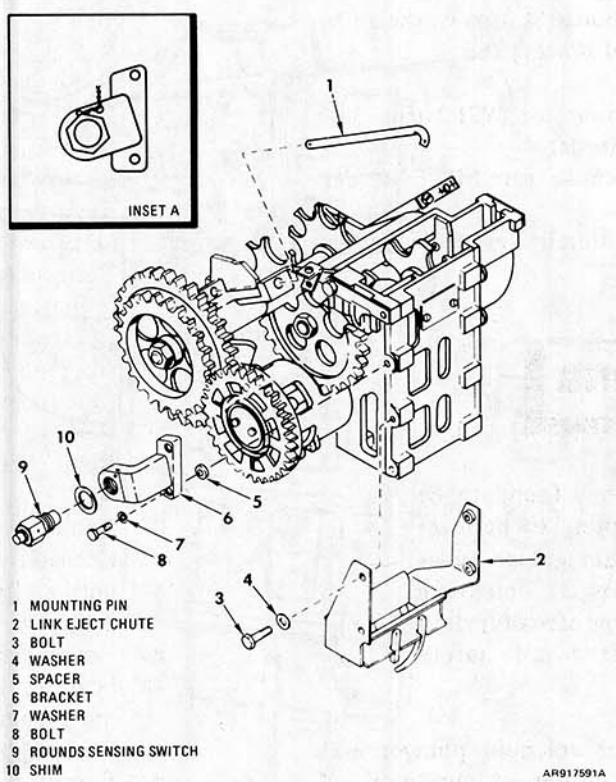


Figure 3-4.1 M89E1 Feeder and Associated Components

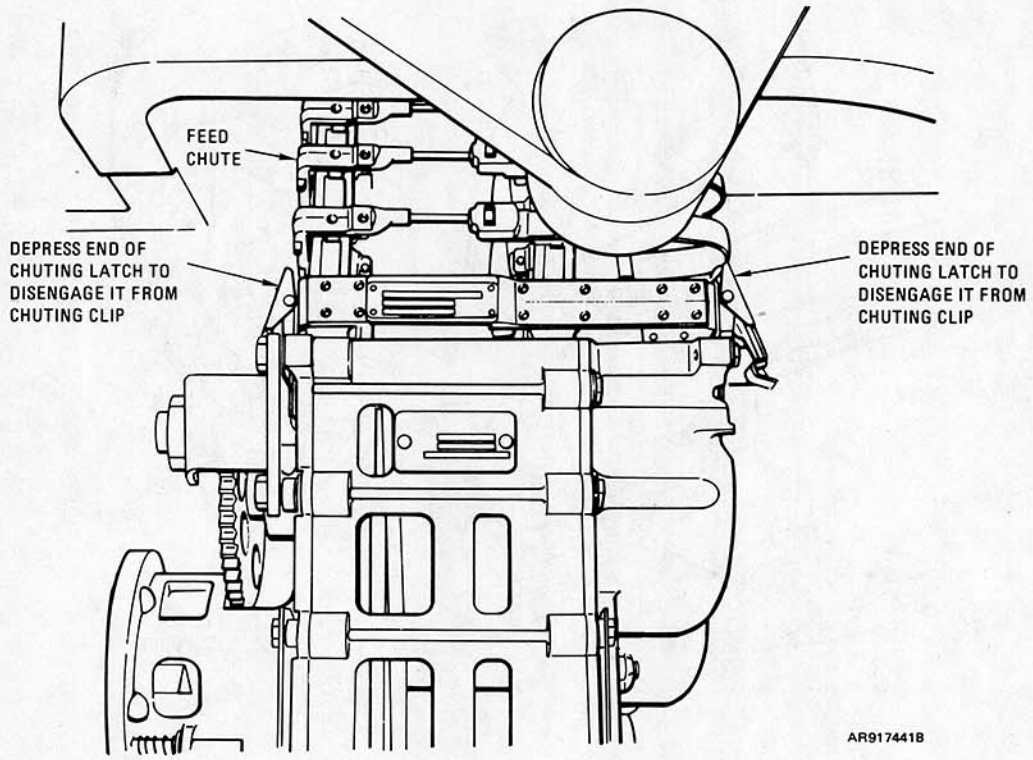


Figure 3-5. Disconnecting Feed Chute from M89E1 Feeder

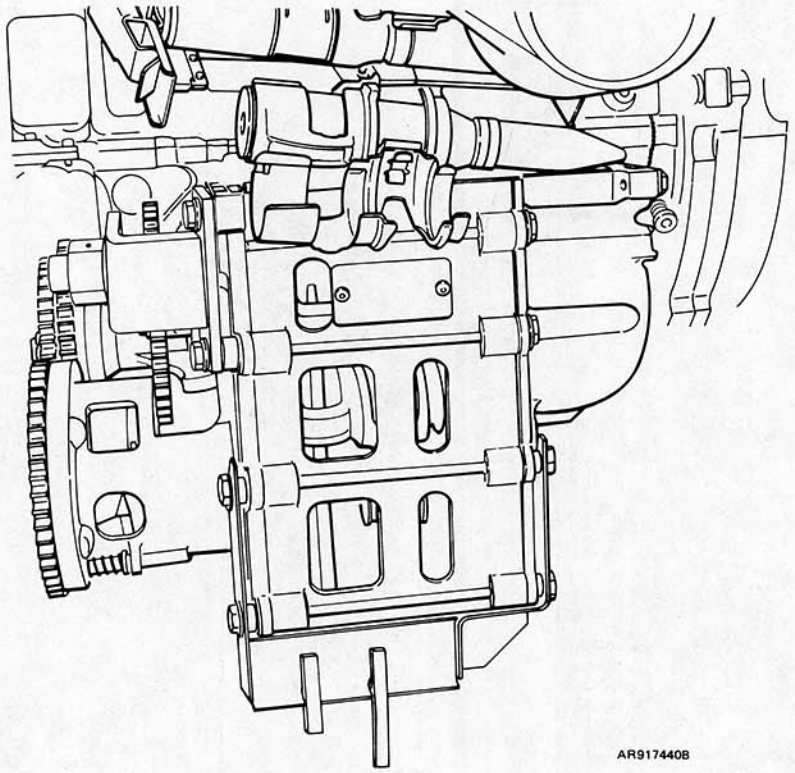


Figure 3-6. Breaking Ammunition Belt at M89E1 Feeder

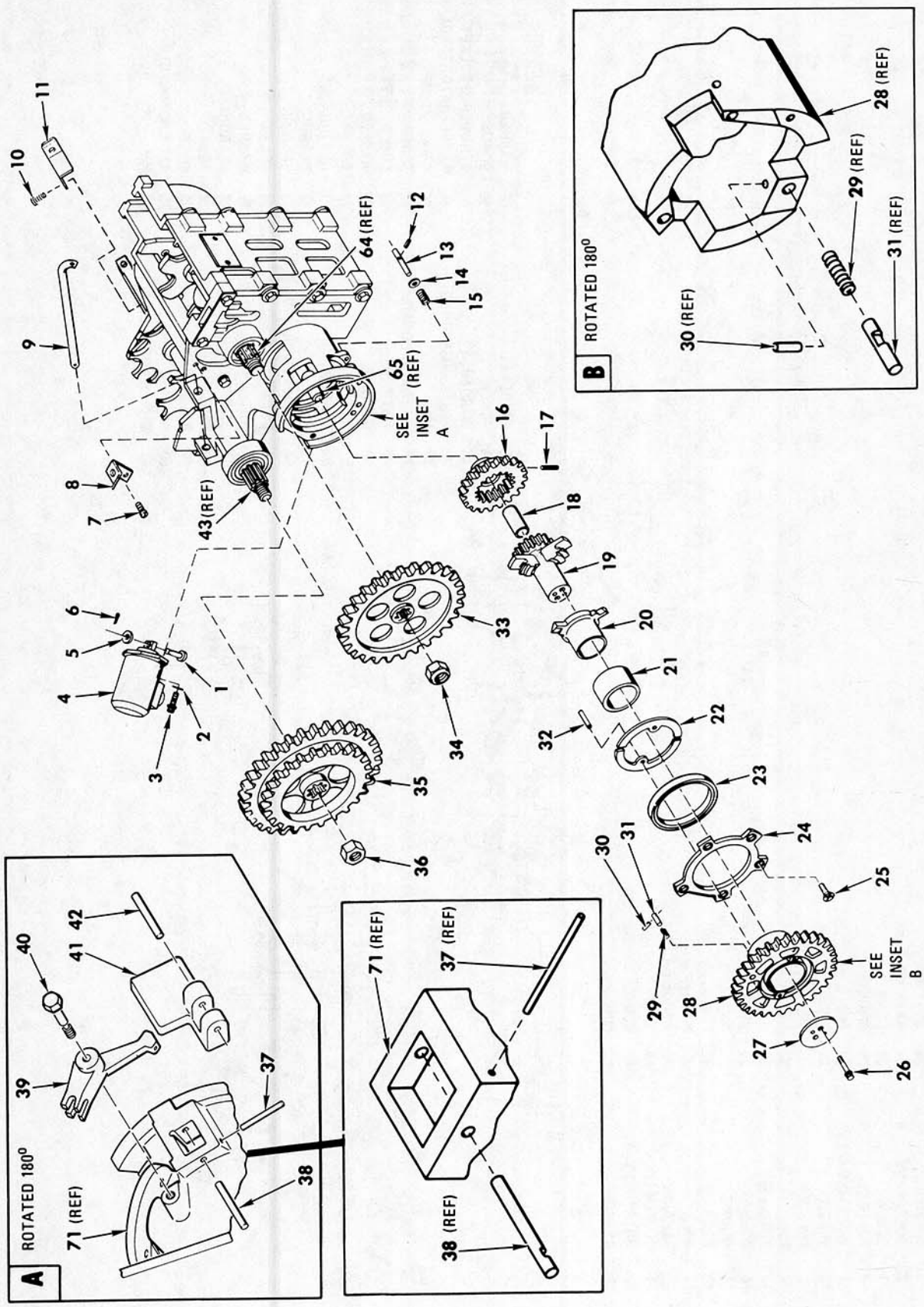
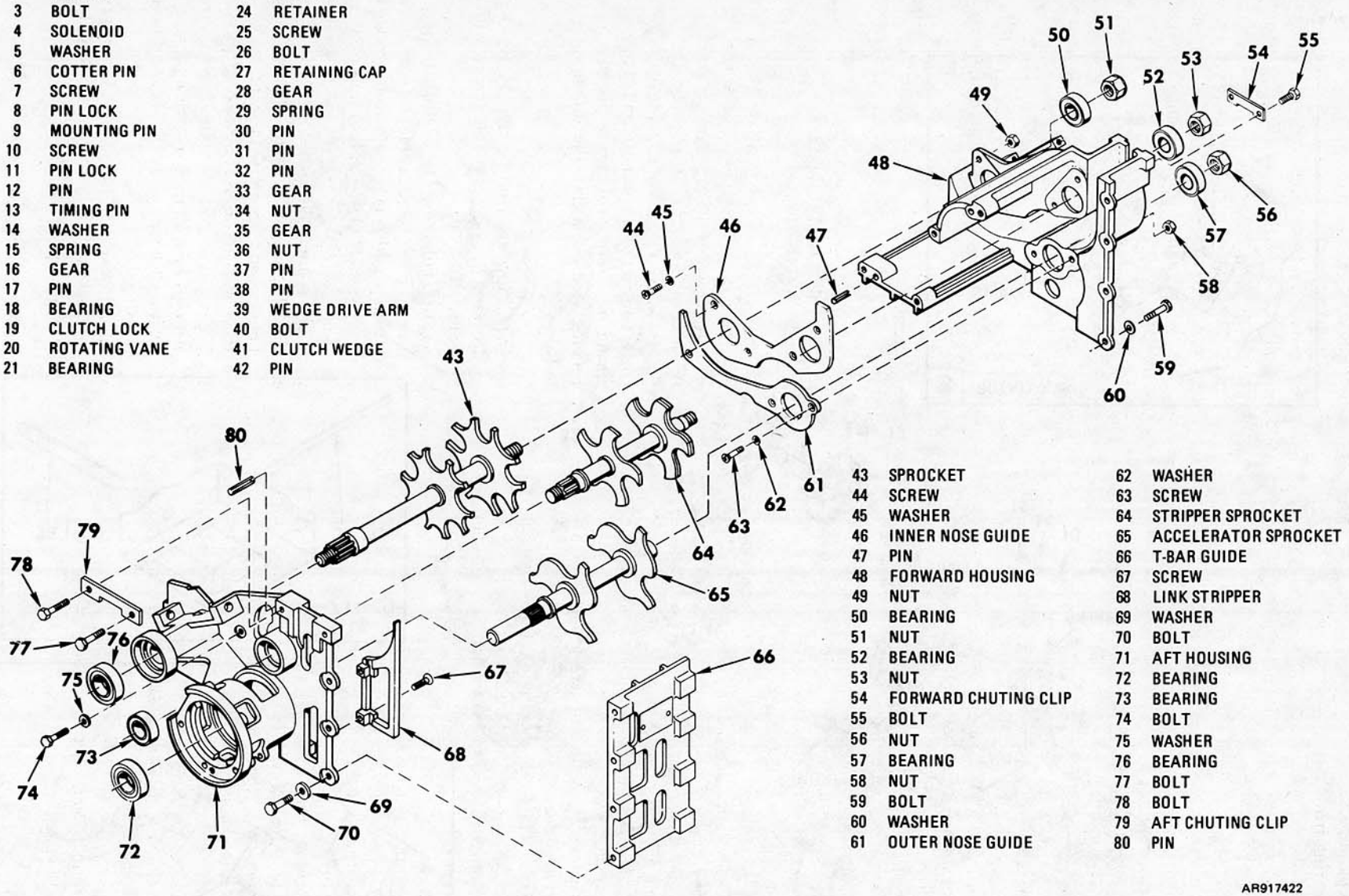


Figure 3-7. M89E1 Feeder — Exploded View (Sheet 1 of 2)

1	PIN	22	RETAINER
2	WASHER	23	BEARING
3	BOLT	24	RETAINER
4	SOLENOID	25	SCREW
5	WASHER	26	BOLT
6	COTTER PIN	27	RETAINING CAP
7	SCREW	28	GEAR
8	PIN LOCK	29	SPRING
9	MOUNTING PIN	30	PIN
10	SCREW	31	PIN
11	PIN LOCK	32	PIN
12	PIN	33	GEAR
13	TIMING PIN	34	NUT
14	WASHER	35	GEAR
15	SPRING	36	NUT
16	GEAR	37	PIN
17	PIN	38	PIN
18	BEARING	39	WEDGE DRIVE ARM
19	CLUTCH LOCK	40	BOLT
20	ROTATING VANE	41	CLUTCH WEDGE
21	BEARING	42	PIN



43	SPROCKET	62	WASHER
44	SCREW	63	SCREW
45	WASHER	64	STRIPPER SPROCKET
46	INNER NOSE GUIDE	65	ACCELERATOR SPROCKET
47	PIN	66	T-BAR GUIDE
48	FORWARD HOUSING	67	SCREW
49	NUT	68	LINK STRIPPER
50	BEARING	69	WASHER
51	NUT	70	BOLT
52	BEARING	71	AFT HOUSING
53	NUT	72	BEARING
54	FORWARD CHUTING CLIP	73	BEARING
55	BOLT	74	BOLT
56	NUT	75	WASHER
57	BEARING	76	BEARING
58	NUT	77	BOLT
59	BOLT	78	BOLT
60	WASHER	79	AFT CHUTING CLIP
61	OUTER NOSE GUIDE	80	PIN

Figure 3-7. M89E1 Feeder — Exploded View (Sheet 2 of 2)

p. Separate lock assembly, bearing, vane, and bearing from gear and attached parts.
q. Drive out two pins (32) securing two retainers (22) to gear (28). Remove retainers.
r. Remove bearing (23) and retainer (24) from gear (28).
s. Remove three pins (30), three pins (31), and three springs (29) from gear (28).
t. Remove pin (12), pin (13), washer (14), and spring (15).
u. Drive out pin (17) securing gear (16) to accelerator sprocket (65). Remove gear.
v. Remove gear (35) from shaft of feeder sprocket (43).
w. Using a soft-faced hammer, drive stripper sprocket (64) toward forward side of housings and remove gear (33).
x. Drive two pins (80 and 47) inward until they are free from aft housing (71).
y. Remove two bolts (77 and 78) securing clip (79). Remove clip.
z. Remove three bolts (70), three washers (69), three bolts (74), and three washers (75) from aft housing. Separate housings. Remove pin (47).
aa. Remove two screws (67) securing stripper (68). Remove stripper.
ab. Remove bearings (72, 73, and 76) from aft housing.
ac. Remove two pins (80 and 47) from forward housing (48).
ad. Remove nut (51) and feeder sprocket (43) from forward housing.
ae. Remove nut (53), bearing (52), and stripper sprocket (64) from forward housing.
af. Remove four bolts (59) and four washers (60) securing T-bar guide (66). Remove T-bar guide.
ag. Remove nut (56) and accelerator sprocket (65) from forward housing.
ah. Remove bearings (50 and 57) from forward housing.
ai. Remove three nuts (58), three washers (62), and three screws (63) securing outer nose guide (61). Remove outer nose guide.
aj. Remove four nuts (49), four washers (45), and four screws (44) securing inner nose guide (46). Remove inner nose guide.
ak. Remove two bolts (55) securing clip (54). Remove clip.

3-21. Cleaning. Clean parts in accordance with paragraph 3-5b and c.

3-22. Inspection.

a. All parts shall be visually inspected and repaired or replaced if found to be defective. Parts shall be cleaned prior to inspection in order to effectively accomplish a complete inspection.

b. Check for bent or cracked link eject chute.

c. Check rounds sensing switch for dented sensing face, bent connector pins, and damaged or defective threads.

d. Check for cracked switch mounting bracket.

e. Table 3-11.1 lists feeder components and possible defects at specified points on the component to assist in accomplishing the visual inspections.

3-23. Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection.

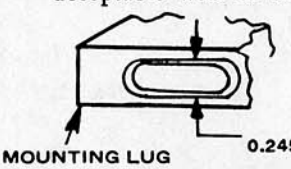
3-24. Assembly.

CAUTION

When installing spring pins, use punch or drift pin with a diameter greater than the inside diameter of the spring pin. Failure to use a punch or drift pin of the correct diameter can peen the end of the spring pin. A peened spring pin may become wedged within the mounting hole.

a. Install forward chuting clip (54, fig. 3-7) on forward housing (48) and secure with two bolts (55).
b. Tighten bolts to 20 to 25 lb-in. torque.
c. Install inner nose guide (46) on forward housing and secure with four screws (44), four washers (45), and four nuts (49). Install two pins (47).
d. Tighten nuts (49) to 20 to 25 lb-in. torque.
e. Install outer nose guide (61) on forward housing and secure with three screws (63), three washers (62), and three nuts (58).
f. Tighten nuts (58) to 20 to 25 lb-in. torque.
g. Apply a light coating of grease (item 2, App D) to all bearings and to bearing bores in housing.
h. Install bearings (50, 52, and 57) in forward housing (48) and bearings (72, 73, and 76) in aft housing (71).

Table 3-11.1 M89E1 Feeder — Parts Inspection

Component	Possible Defect	Remedy
Inner nose guide	Broken or bent	Replace inner nose guide.
Outer nose guide	Broken or bent	Replace outer nose guide.
Bearings	Hard to turn, broken, or missing components	Replace defective bearings.
Forward feeder housing	Cracked or broken	Replace forward feeder housing.
Aft feeder housing	Cracked or broken	Replace aft feeder housing.
Wedge	Broken or cracked	Replace wedge.
Stripper sprocket	Bent, cracked or broken	Replace defective stripper sprocket.
Spur gears	Broken, cracked, or missing teeth	Replace spur gears.
Cluster gear	Broken, cracked, or missing teeth	Replace cluster gear.
Accelerator sprocket drive spur gear	Burred holes for anti-backlash pins	Remove burrs.
Feeder sprocket	Bent, cracked or broken	Replace defective feeder sprocket.
Stripper	Cracked, bent, or broken	Straighten if possible. Replace defective stripper.
Cap	Cracked or broken	Replace cap.
Retainer	Broken or cracked	Replace retainer.
Vane	Worn or broken	Replace vane.
Lock assembly	Worn bearing; broken or chipped insert	Replace lock assembly.
Accelerator sprocket	Bent, cracked or broken	Replace defective accelerator sprocket.
Mounting pin inserts	Elongated holes. Maximum acceptable wear as shown below. 	Replace forward housing.
T-Bar guide assembly	Cracked or excessively worn rail (edge worn through)	Replace.

i. Place accelerator sprocket (65) in forward housing and secure with nut (56). Tighten nut finger-tight.
j. Install T-bar guide (66) on forward housing and secure with four bolts (59) and four washers (60). Tighten bolts finger-tight.
k. Place stripper sprocket assembly (64) in forward housing and secure with nut (53). Tighten nut finger-tight.
l. Place feeder sprocket (43) in forward housing and secure with nut (51). Tighten nut finger-tight.
m. Install stripper (68) on aft housing (71) and secure with two screws (67).
n. Tighten screws to 25 to 35 lb-in. torque. Stake each screw at two places.
o. Install aft housing and secure with three bolts (70), three washers (69), three bolts (74), and three washers (75). Tighten bolts finger-tight.
p. Install clip (79) and secure with two bolts (77 and 78). Tighten bolts finger-tight.
q. Tighten bolts (78, 77, 74, 59, and 70) sufficiently to draw forward and aft housings together but still permit movement of parts.
r. Install two pins (80 and 47).
s. Tighten bolts (78, 77, 74, 59, and 70) to 140 to 150 lb-in. torque.
t. Position shaft of stripper sprocket (64) toward forward housing to obtain clearance for installation of gear (33).
u. Align and install gear (33), timing mark outward, on shaft of stripper sprocket (64) and secure with nut (34). Tighten nut finger-tight.
v. Align and install cluster gear (35), timing mark outward, on shaft of feeder sprocket (43), and secure with nut (36). Tighten nut finger-tight.
w. Start pin (17) into gear (16) from side opposite timing mark.
x. Install gear (16) on shaft of accelerator sprocket (65) so that timing mark on gear (16) is aligned with timing mark on gear (33) and secure gear (16) to shaft with pin (17).
y. Install spring (15), washer (14), and timing pin (13). Secure with pin (12).

CAUTION

If the M89E1 is to be used at temperatures below 0°F (-18°C), oil (item 9, App D) shall be used on all internal clutch parts instead of oil (item 3, App D).

z. Lubricate shaft of lock assembly (19) with oil (item 3, App D). Lubricate gear teeth on lock assembly with grease (item 2, App D).
aa. Lubricate internal teeth of gear (16) with grease (item 2, App D).
ab. Install bearing (18), if removed, in clutch lock (19).
ac. Align missing tooth on clutch lock (19) with timing mark on gear (16). Rotate gear (33) allowing tabs of lock assembly to fully engage corresponding slots in housing.

NOTE

When performing following step, pin (31) must be properly positioned (fig. 3-7, inset B) before pin (30) can be installed.

ad. Install three springs (29) and three pins (31) in gear (28) and secure with three pins (30). Drive pins flush with surface of gear.
ae. Place retainer (24), countersunk holes facing gear, and bearing (23) on gear (28).
af. Place two retainers (22) in slots in gear (28) and secure with two pins (32).
ag. Lubricate inner surface of gear (28) with oil (item 3, App D).
ah. Lubricate bearing (21) and rotating vane (20) with oil (item 3, App D).
ai. Insert rotating vane (20) in bearing (21) using a twisting motion.
aj. Install assembled bearing and rotating vane in gear (28) using a twisting motion.

NOTE

When performing following step, flat on side of retainer (24) must be toward gear (35) and tabs of vane (20) must enter corresponding slots in housing.

ak. Place five screws (25) in position in retainer (24): then install gear (28) and attached components on lock assembly (19) so that timing mark on gear (28) is aligned with timing mark on gear (35). After installation, check timing of gears.

CAUTION

Exercise care when performing following step to avoid deforming retainer and binding gear.

al. Tighten each screw (25) a few turns at a time until all screws are snug. Check for binding and timing of gears.
am. Tighten screws (25) to 35 to 45 lb-in. torque.
an. Restrain gears from turning using a soft material in gear teeth.
ao. Install retaining cap (27) and secure with two bolts (26).
ap. Tighten bolts (26) to 80 to 90 lb-in. torque.
aq. Tighten nuts (36, 34, 51, 53, and 56) to 160 to 200 lb-in. torque.
ar. Remove soft material from gear teeth.

NOTE

When performing following step, pin (38) must be properly positioned (slot away from housing as shown in figure 3-7, inset A) before pin (37) can be installed.

as. Install clutch wedge (41) in aft housing and secure with pin (38) and pin (37).
at. Install pin (42) in wedge.
au. Engage wedge drive arm (39) with wedge and secure wedge drive arm to aft housing with bolt (40). Tighten bolt (40) to 20 to 25 lb-in. torque.
av. Install pin (1), washer (5), and cotter pin (6) on solenoid plunger.

CAUTION

Exercise care when performing following step. Washer must be positioned against side of arm nearest housing to prevent disengagement of linkage (see fig. 3-7, sheet 1).

aw. Engage solenoid plunger with arm (39). Make certain pin (1) and washer (5) are properly positioned to prevent disengagement of linkage.

CAUTION

When performing following step, make certain spring is present and properly positioned in solenoid plunger for proper solenoid action.

ax. Install body of solenoid (4) and secure with two bolts (3) and two washers (2).
ay. Tighten bolts to 45 to 60 lb-in. torque.
az. Place locks (8 and 11) in position and secure with four screws (7 and 10).
ba. Lockwire four screws (7 and 10) and two bolts (26) as shown in figure 3-7.1.
bb. Lockwire two bolts (3) as shown in figure 3-7.1.
bc. Install two mounting pins (9, fig. 3-7) and engage locks (8 and 11).

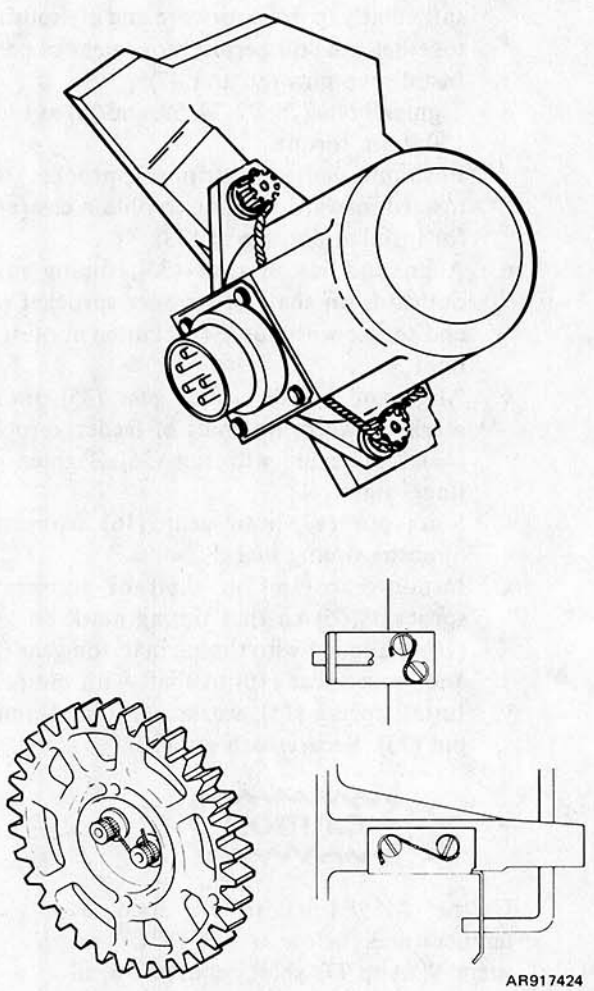


Figure 3-7.1 Lockwiring Details

3-24.1 Post-Assembly Checkout.

a. Notify aviation intermediate maintenance to check alignment of aft rim guide and feeder sprockets in accordance with TM 9-1090-206-30.

b. Rotate the drive sprocket by hand. In the declutching position, this sprocket should rotate freely but the sprocket assemblies should lock. In the fire or operating position all sprocket assemblies should rotate freely.

c. Attach two to three feet of chuting to the feeder. Pass a short belt of M254 or M51A1B1 dummy cartridges, belted in M14 links, through the feeder to check the overall operation, timing, and stripping action. Satisfactory operation is evidenced by passage of the test rounds without binding or jamming of the feeder.

3-25. Installation.

NOTE

The M89E1 feeder, rounds sensing switch, and link eject chute can be installed individually or as a group.

a. *M89E1 Feeder.*
 (1) Time gun and feeder.
 (2) While holding feeder timing pin fully depressed, place feeder in position on gun and install two mounting pins (1, fig. 3-4.1).
 (3) Check that gun and feeder timing pins (fig. 3-8) can be fully depressed simultaneously.
 (4) Mount feed chute (fig. 3-5) and check that chuting clips are fully engaged.
 (5) Connect connector W2P2 (fig. 3-4) to feeder.
 (6) Connect connector W2P1 (fig. 3-4) at aft end of saddle.

b. *Rounds Sensing Switch.*
 (1) Position bracket (6, fig. 3-4.1) on M89E1 feeder and secure with two bolts (8), two washers (7), and spacer (5).
 (2) Install rounds sensing switch (9) into bracket (6), using shim (10) as required, to obtain gap specified in figure 3-8.1. Lockwire rounds sensing switch as shown in inset A of figure 3-4.1.
 (3) Connect connector W5P3 to rounds sensing switch (9, fig. 3-4.1).

c. *Link Eject Chute.* Position link eject chute (2) on M89E1 feeder and secure with four bolts (3) and four washers (4).

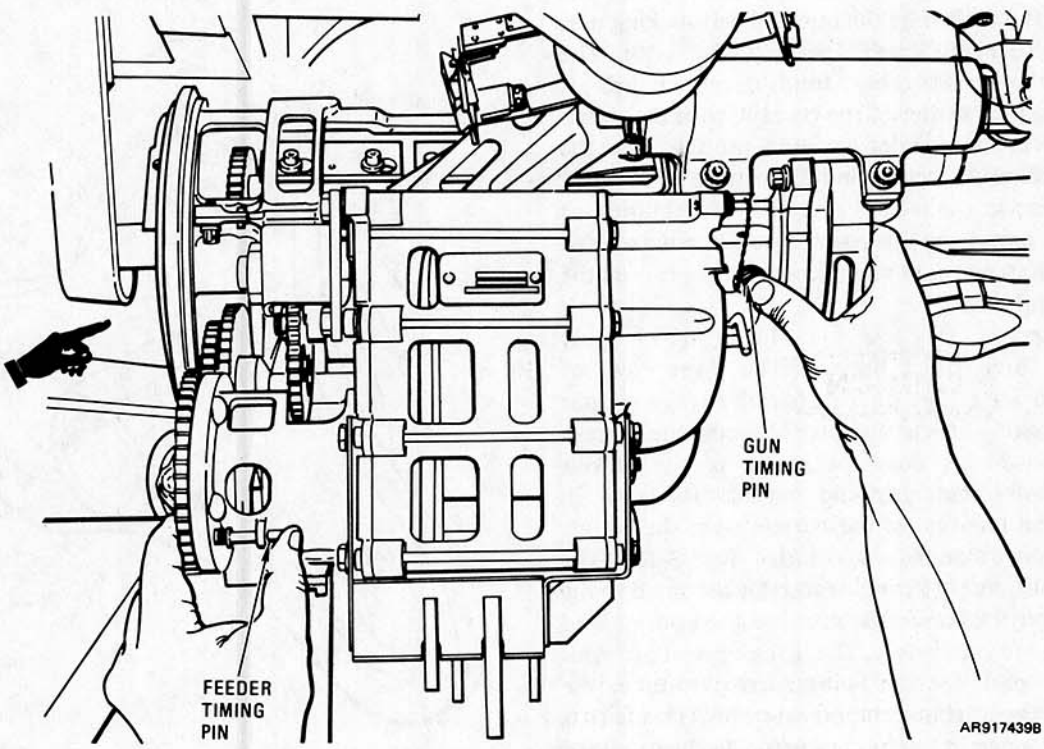


Figure 3-8. Checking M89E1 Feeder and M197 Gun Timing

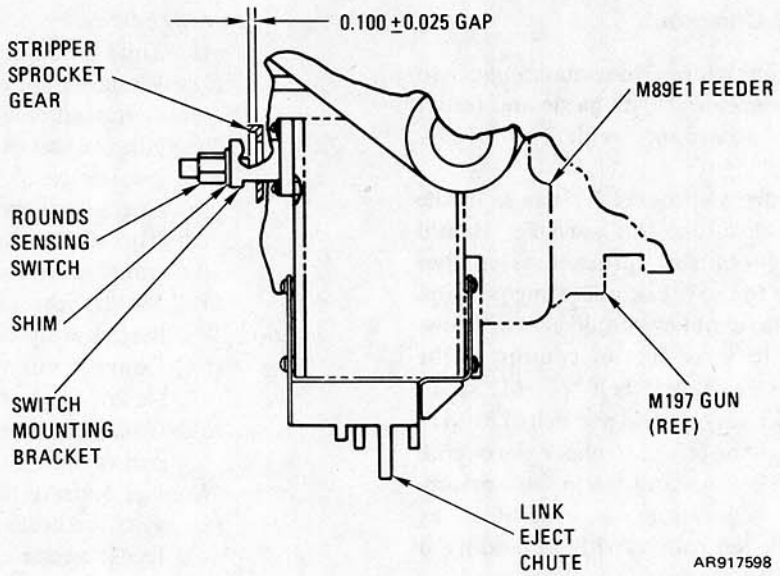


Figure 3-8.1 Rounds Sensing Switch — Adjustment Details

Section VI. MAINTENANCE OF M197 GUN

3-26. Description.

a. *Muzzle Clamp Plate and Associated Parts* (fig. 3-9). The muzzle clamp plate is positioned at the outer end of the barrels to restrain individual barrel movement during firing. It is positioned against the shoulders on the barrels and secured against the opposite side of the shoulders on the barrels by the bolt and self-locking nut.

b. *Mid-Barrel Clamp Assembly* (fig. 3-10). The mid-barrel clamp assembly (mid-barrel clamp) is positioned near the center of the barrels, with the clamp tabs engaged in the slots of the stop shoulders on the barrels. The clamp is secured in this position by rotating the locking disc to the locked position. The rotation of the gun, the barrel detents, and a cotter pin inserted through the locking disc and clamp plate prevent the clamp from unlocking.

c. *Barrels* (fig. 3-11). The M197 gun incorporates three rifled barrels. The three rows of interrupted locking lugs on the barrel engage similar interrupted locking lugs in the rotor to secure the barrels. Three knurled bands near the center of the barrels provide a convenient gripping surface for ease in installation and removal of the barrels from the rotor.

d. *Firing Contact Assembly* (fig. 3-12). The firing contact assembly (firing contact) is mounted to the housing so that the connector is above the housing and the spring-loaded cam below. The firing contact provides the necessary path for the firing current to enter the housing and reach the breech bolt assembly. This path is through the connector to the conductor, to the insulated insert in the contact cam assembly, and to the breech bolt assembly and finally through the breech bolt assembly to the electrically-primed ammunition.

e. *Breech Bolt Assembly* (fig. 3-13). There are three breech bolt assemblies used in the gun. The improved breech bolt assembly differs from the standard

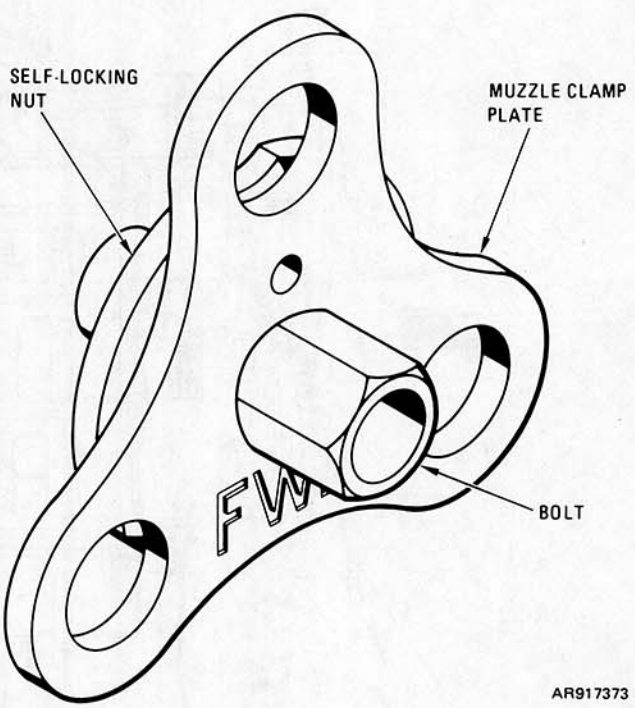


Figure 3-9. Muzzle Clamp Plate and Associated Parts

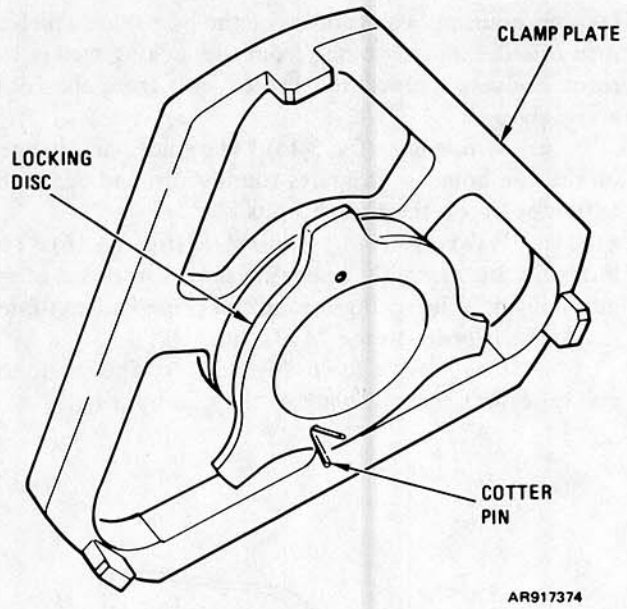


Figure 3-10. Mid-Barrel Clamp Assembly

breech bolt assembly in internal construction and parts life. The breech bolt assemblies are interchangeable in sets of three. Intermixing the two types of breech bolts in the M197 gun is not recommended. Each breech bolt assembly (breech bolt) picks up a round as it enters the gun, transports it to the firing chamber, locks it into firing position, transmits the firing voltage to the primer of the round, extracts the empty case from the chamber, and transports the empty case to the guide bar where it is cammed out of the gun. An extractor lip on the front of each breech bolt engages the rim of a round and controls the round throughout the various actions. Guide slots or grooves on the side of the bolt body permit it to slide on the rotor tracks. The bolt roller shaft determines the position of the breech bolt as it follows the main cam path or the clearing cam path in the housing assembly. Each breech bolt consists of a bolt shaft assembly (bolt shaft), locking block, firing circuit components, and a breech bolt body.

f. *Front and Rear Unlocking Cams* (fig. 3-14). The front and rear unlocking cams are mounted on

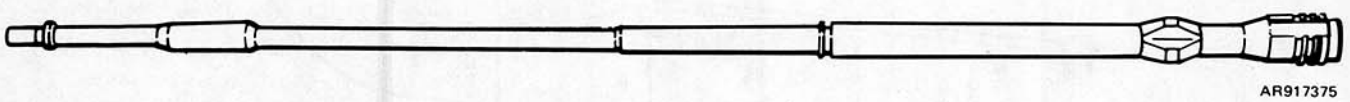


Figure 3-11. Barrel

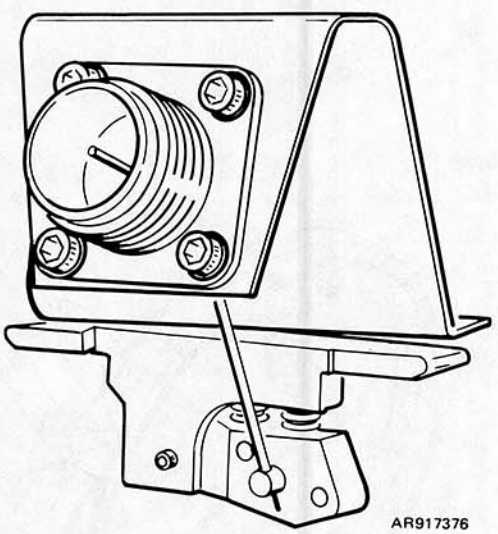


Figure 3-12. Firing Contact Assembly

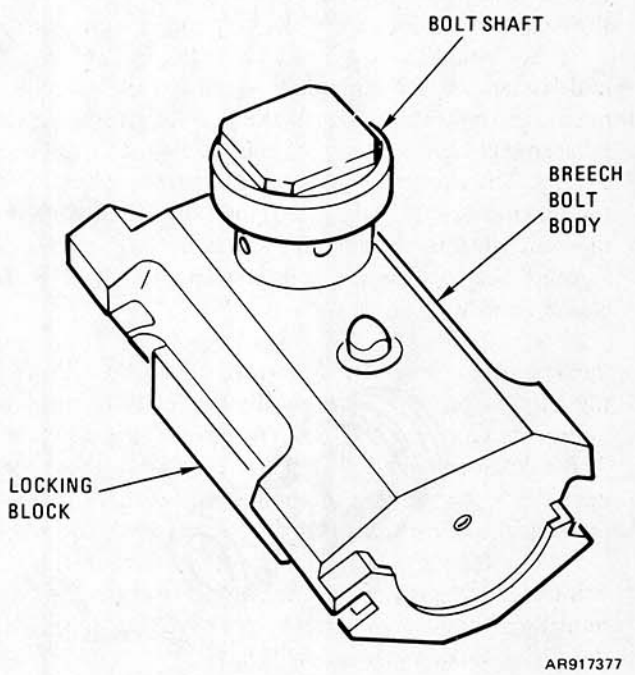


Figure 3-13. Breech Bolt Assembly

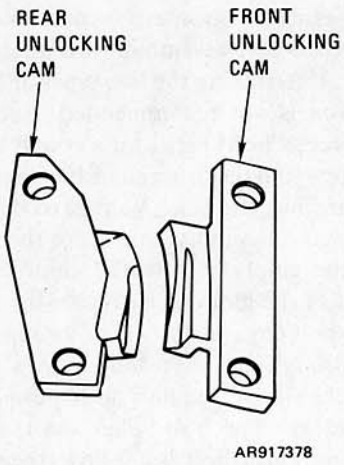


Figure 3-14. Front and Rear Unlocking Cams

the gun housing. The cams raise the bolt shaft which in turn lifts the locking block from the locking well in the rotor body to unlock the breech bolt from the rotor assembly.

g. *Guide Bar* (fig. 3-15). The guide bar is located on the gun housing. It guides rounds into and out of the extractor lip on the breech bolts.

h. *Indexing Pin Assembly* (fig. 3-16). The indexing pin assembly (indexing pin) is installed in the gun housing. The spring-loaded pin is used when timing the M89E1 feeder to the M197 gun.

i. *Coupling Clamp* (fig. 3-17). The coupling clamp secures the end plate to the gun housing.

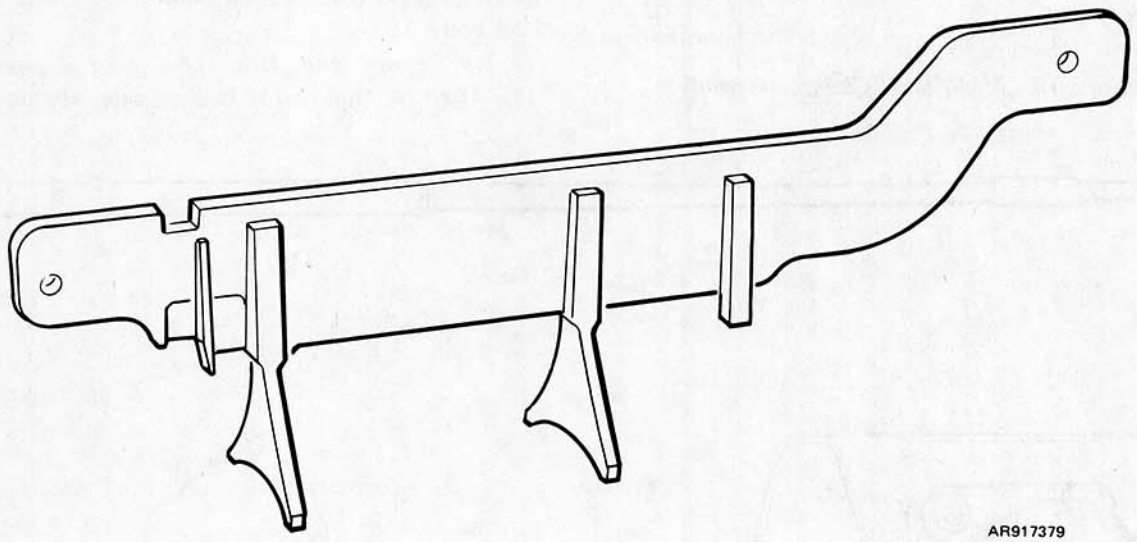


Figure 3-15. Guide Bar



Figure 3-16. Indexing Pin Assembly

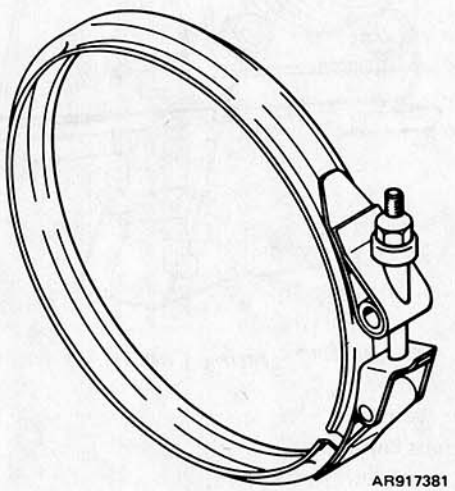


Figure 3-17. Coupling Clamp

3-27. Unscheduled Maintenance.

WARNING

Failure to perform a bore erosion test at scheduled intervals may result in ruptured barrels when the gun is fired and cause death or injury to personnel and damage to equipment.

a. *Long Burst.* If there is any reason to suspect that the gun has fired a long burst (300 rounds or more) or a series of short bursts (totaling up to 400 rounds or more in a 10-minute period), inspect gun barrels in accordance with paragraph 3-31.

WARNING

If a sudden stoppage is experienced, clear gun and/or feeder immediately. Follow a clearing procedure based on type of malfunction encountered. Observe all safety precautions.

b. *Sudden Stoppage.* A sudden stoppage of the gun is usually caused by a misfeed, double feed, broken bolt shaft assembly, firing out of lock, or foreign material (nut or bolt, etc) lodged between the breech bolt body and the locking block. Any malfunction of this type will stop the gun almost instantaneously and damage to the gun drive, M89E1 feeder, and the ammunition feed system will frequently occur as a result of the stoppage. The gun, gun drive, M89E1 feeder, and ammunition feed system will be returned to next higher maintenance level for special maintenance.

c. *Component Malfunction.* Unscheduled maintenance following a component malfunction not involving a sudden stoppage will consist of the following:

(1) A thorough examination of the M197 gun to assist in isolating and correcting the malfunction.

(2) Fault detection and isolation using troubleshooting instructions provided in paragraph 3-9.

(3) Inspection of all components associated with the malfunction (para 3-31). The M197 gun shall be disassembled in accordance with paragraph 3-29 to accomplish the inspection. If complete inspection and repair cannot be accomplished at aviation unit level, return complete M197 gun to next higher maintenance level.

3-28. Removal.

a. Remove M89E1 feeder (para 3-19).

a.1. Remove lockwire and disconnect connector W2P3 from M197 gun.

b. Remove gun drive (para 3-36).

b.1. Deleted.

WARNING

Keep fingers clear of gun rotor, breech bolts, and other movable parts. Rear of gun must be supported at non-rotating, non-reciprocation areas to avoid injury to hands/fingers if barrel cluster is accidentally rotated.

NOTE

If desired, barrels may be removed before performing following step. (Reference paragraph 3-29).

c. Remove cable straps securing bails of quick-release pins to saddle. With two men supporting gun, remove two quick-release pins securing M197 gun in saddle; then, lower M197 gun until recoil adapter and slider clear saddle lugs. Slide M197 gun forward to disengage it from rear mount on saddle and remove M197 gun from turret.

d. Remove recoil attenuation system (para 3-41).

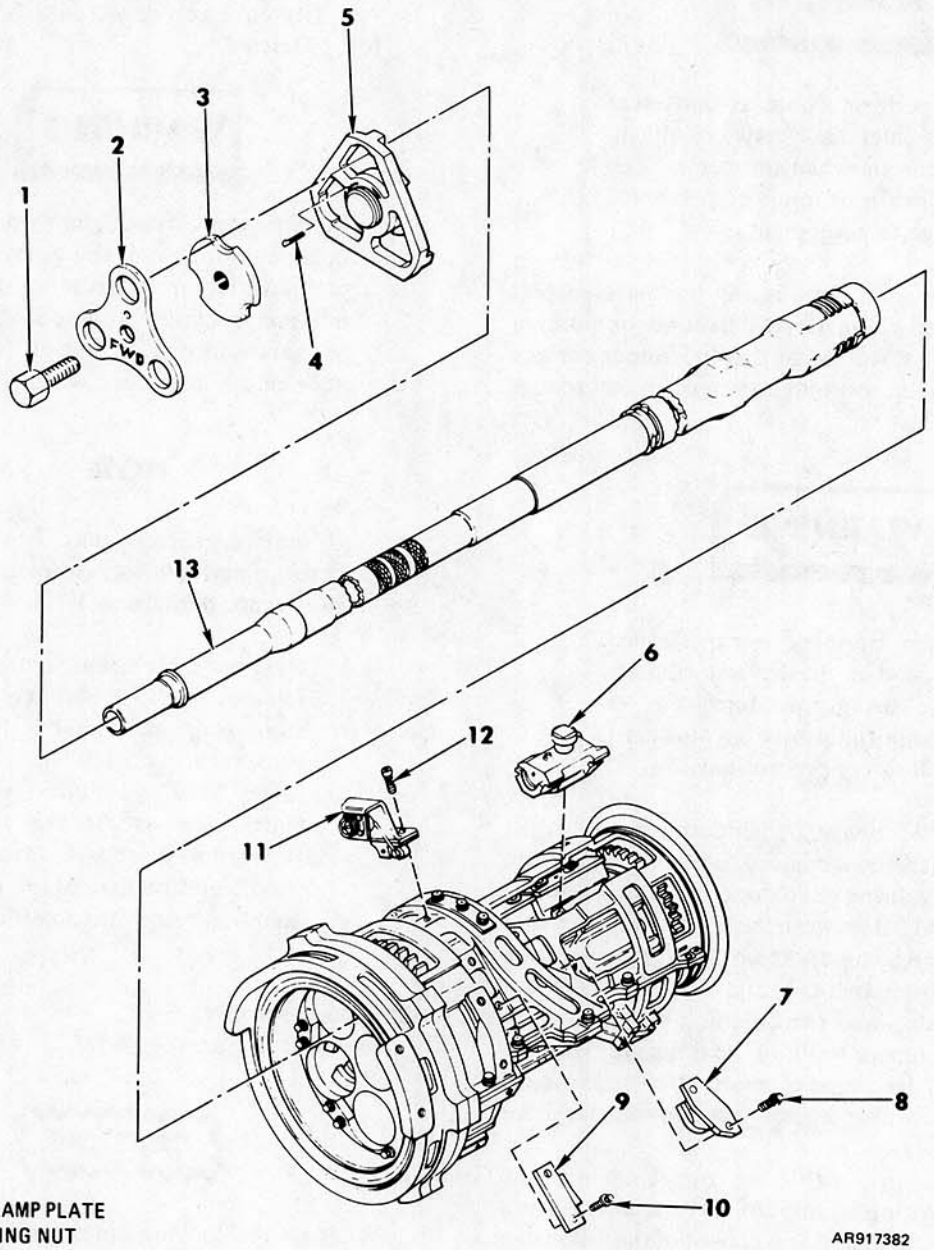
3-29. Disassembly.

a. *M197 Gun* (fig. 3-18).

CAUTION

Hold self-locking nut assembly against front plate until it is sufficiently loose to back off. Do not use index pin assembly to restrain barrel cluster while loosening muzzle clamp bolt. A suitable restraining device, such as bar or screwdriver, should be placed directly behind muzzle clamp to prevent barrel cluster distortion.

(1) Loosen bolt (1, fig. 3-18) until self-locking nut (3) behind muzzle clamp



1 BOLT
2 MUZZLE CLAMP PLATE
3 SELF-LOCKING NUT
4 COTTER PIN
5 MID-BARREL CLAMP
6 BREECH BOLT
7 REAR UNLOCKING CAM
8 BOLT
9 FRONT UNLOCKING CAM
10 BOLT
11 FIRING CONTACT
12 SCREW
13 BARREL

Figure 3-18. M197 Gun — Exploded View (Sheet 1 of 2)

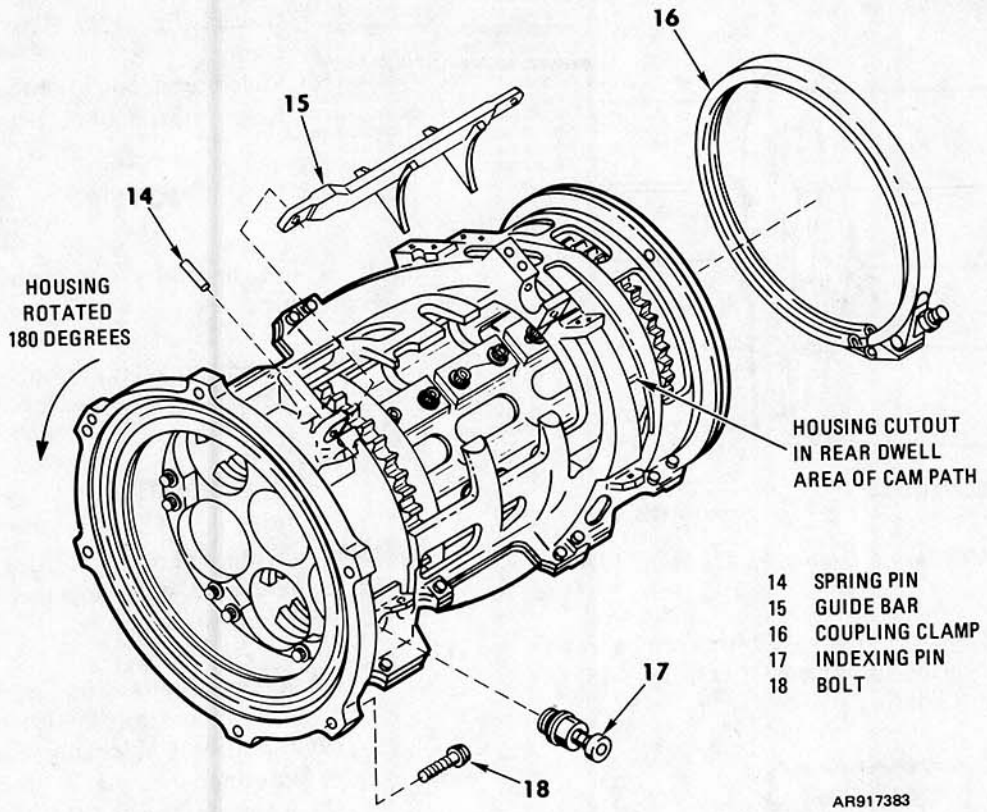


Figure 3-18. M197 Gun — Exploded View (Sheet 2 of 2)

plate (2) is free of shoulders on barrels (13). (See fig. 3-19.)

(2) Rotate self-locking nut until free from barrel flanges.

(3) Pull muzzle clamp plate forward until free from barrels. If necessary, tap clamp plate free from barrels with soft-faced hammer.

(4) Remove cotter pin (4, fig. 3-18) from locking disc and clamp plate. (See fig. 3-20.)

(5) Place drift against locking disc tang and rotate disc to unlock position shown by arrow on clamp plate.

(6) Pull mid-barrel clamp off muzzle end of barrels. If necessary, tap clamp free from barrels with soft-faced hammer.

(7) Rotate barrel approximately 60 degrees in either direction until barrel lugs are disengaged from lugs in rotor.

(8) Pull barrel forward to remove from rotor.

(9) Repeat steps (7) and (8) above for remaining two barrels.

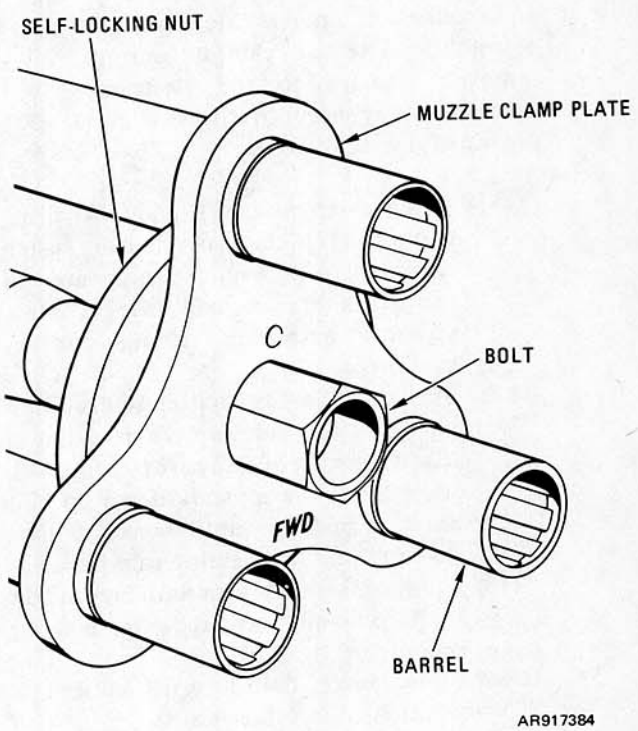


Figure 3-19. Muzzle Clamp Plate — Location View

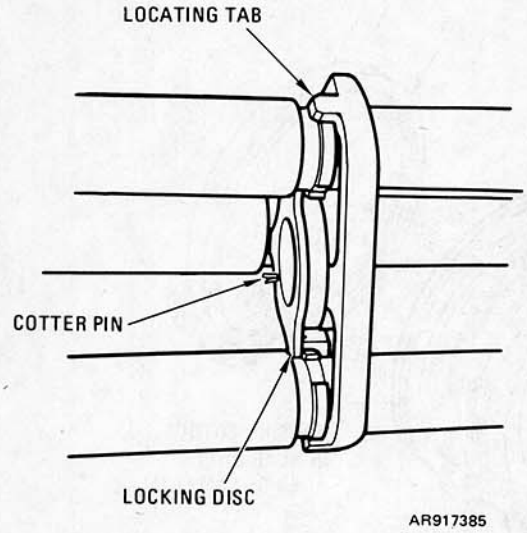


Figure 3-20. Mid-Barrel Clamp — Location View

(10) Remove lockwire between screws securing firing contact (11, fig. 3-18) to gun housing.

CAUTION

The firing contact support assembly and connector bracket are separate assemblies. Exercise caution during removal: damage to the electrical conductor may occur if the two are separated during removal.

(11) Remove screws (12) and lift firing contact (11) clear of housing using caution to prevent separation of connector bracket and firing contact support assembly (firing contact support).
(12) Turn rotor in direction of gun rotation until a breech bolt appears in cutout in rear dwell area of cam path (see fig. 3-18, sheet 2). While pressing down on bolt shaft, turn rotor until breech bolt is diverted into the clearing cam path.
(13) Continue turning rotor until breech bolt is approximately centered in top housing cutout (see fig. 3-21).
(14) Slide breech bolt forward until it is positioned on center tracks.
(15) Depress track lock pin in one removable track and move track until clear of track spacers (fig. 3-21). Remove track from rotor.
(16) Slide breech bolt aft into rear rotor well. Remove breech bolt from rotor.

NOTE

It is not necessary to remove the remaining track.

(17) Repeat steps (12) through (16) above for remaining two breech bolts.

NOTE

Identify front and rear unlocking cams as a pair and store together until required for installation.

(18) Remove bolts (10, fig. 3-18) securing front unlocking cams (9) to rear housing.
(19) Lift front unlocking cam from rear housing.
(20) Remove bolts (8) securing rear unlocking cam (7) to rear housing.
(21) Lift rear unlocking cam from rear housing.
(22) Drive out spring pin (14) retaining forward end of guide bar (15) in gun housing.

NOTE

A long drift is required for rear spring pin removal.

(23) Drive out spring pin retaining rear end of guide bar in gun housing.

CAUTION

A bent guide bar may be difficult to remove from gun housing. Use caution during removal to prevent housing damage.

(24) Remove guide bar (15) from gun housing.

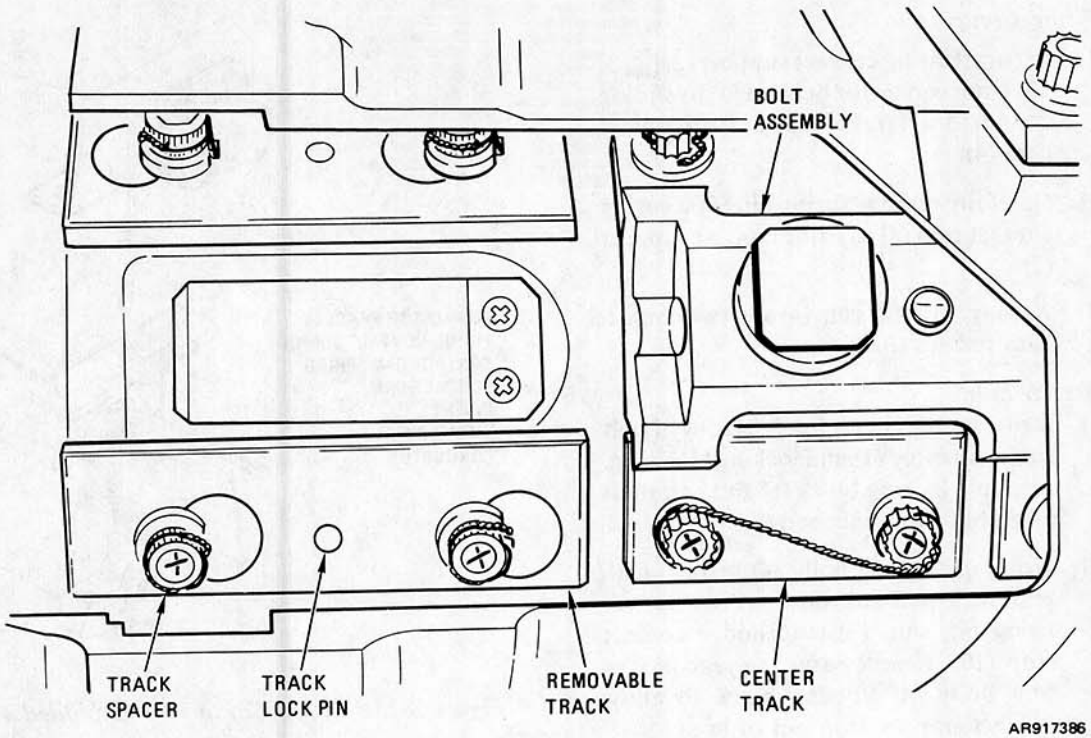


Figure 3-21. Track Removal

(25) Remove lockwire from indexing pin assembly (17).

(26) Remove indexing pin assembly (17) from gun housing.

(27) Loosen nut on coupling clamp (16) T-bolt sufficiently to disengage bolt from latch.

(28) Raise latch and release bolt.

(29) Remove coupling clamp (16) from end plate and gun housing flanges.

b. *Mid-Barrel Clamp.*

(1) Remove retaining ring (1, fig. 3-22) from groove in locking disc (4).

(2) Separate locking disc from clamp plate (2) over a small container. Three detent plungers (6) and three springs (5) will fall into container as locking disc is separated from clamp plate.

(3) Drive spring pin (3) from locking disc body.

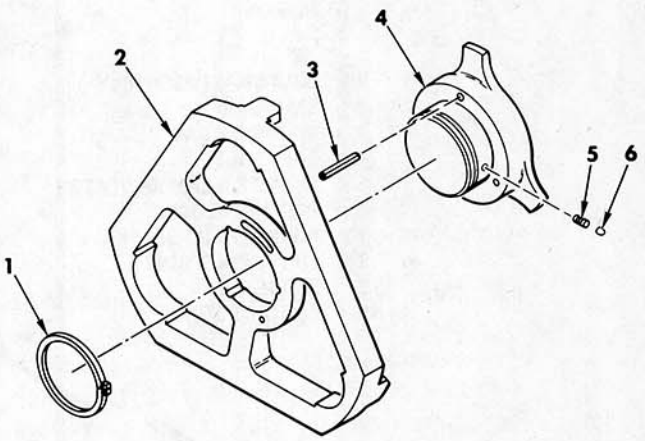


Figure 3-22. Mid-Barrel Clamp — Exploded View

c. *Firing Contact.*

(1) Separate firing contact support (2, fig. 3-23) from connector bracket (1) by sliding conductor (7) out of insert (5) on contact cam (4).

(2) Carefully remove spring pin (6) securing contact cam (4) to firing contact support (2).

(3) Remove contact cam (4) and two contact cam springs (3).

d. *Breech Bolt.*

(1) Drive spring pin (2, fig. 3-24) out of bolt shaft assembly (1) and locking block lug. Separate locking block (6) and bolt shaft assembly from bolt body.

(2) Hold breech bolt body (4) vertical with rear face pointing down. Press top of firing pin cam (3) to dislodge contact stop (10). If necessary, tap rear face of bolt body on wooden block to allow contact stop to drop out of body.

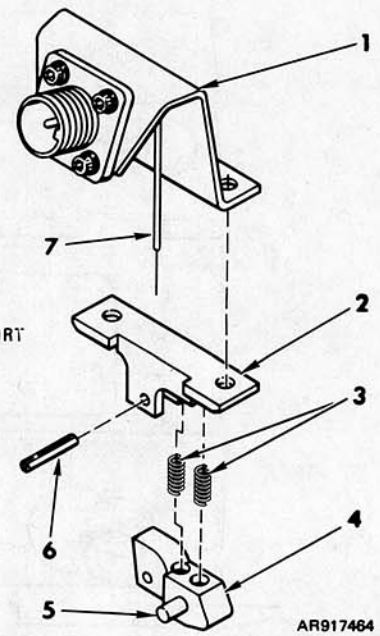


Figure 3-23. Firing Contact — Exploded View

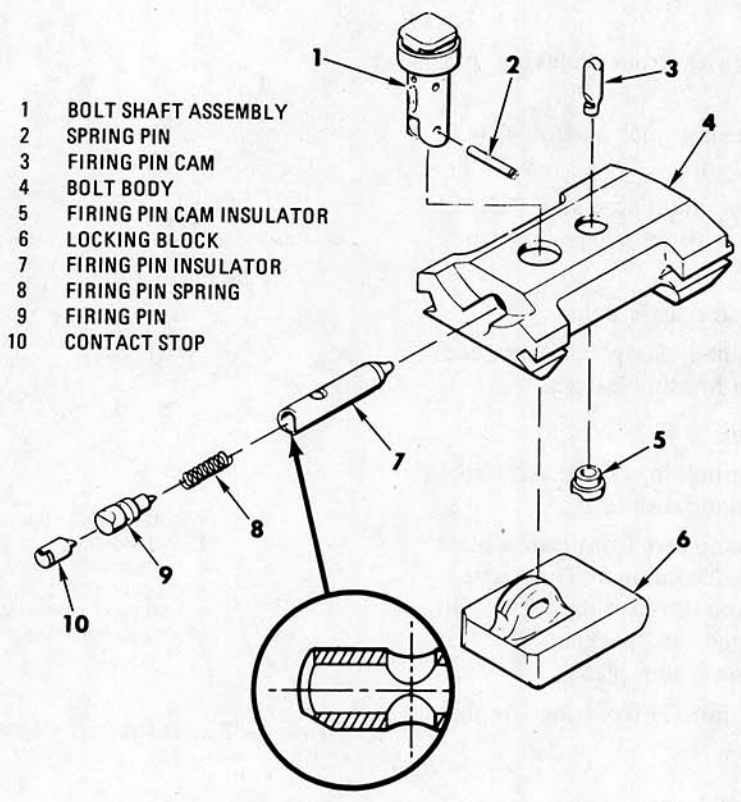


Figure 3-24. Breech Bolt — Exploded View

WARNING

When removing firing pin cam, the firing pin may be propelled from bolt body with sufficient force to cause injury to personnel. Rest aft face of bolt body on working surface so firing pin will be retained within the bolt body.

(3) Stand aft face of breech bolt body on suitable working surface. Insert a drift into hole in bottom of bolt body and press on bottom of firing pin cam (3), forcing cam out of bolt body.

(4) As drift is withdrawn, firing pin (9) will be ejected from firing pin insulator (7) in bolt body.

(5) Tap aft face of breech bolt body sharply on wooden block to dislodge firing pin spring (8) and firing pin insulator from bolt body. Remove spring and insulator.

(6) Apply slight inward pressure on firing pin cam insulator (5), forcing insulator out of hole permitting it to fall free from bolt body.

d.1. *Breech Bolt.*

(1) Drive spring pin (1, fig. 3-24.1) out of bolt shaft assembly (2) and locking block lug. Separate locking block (8) and bolt shaft assembly from breech bolt body (3).

WARNING

When removing cam pin, firing pin may be propelled from breech bolt body with sufficient force to cause injury to personnel. Hold aft face of breech bolt body on working surface so firing pin will be retained within breech bolt body.

(2) Stand aft face of breech bolt body (3) on a suitable working surface. Using a drift, press on top of cam pin (9) to force cam pin out of breech bolt body.

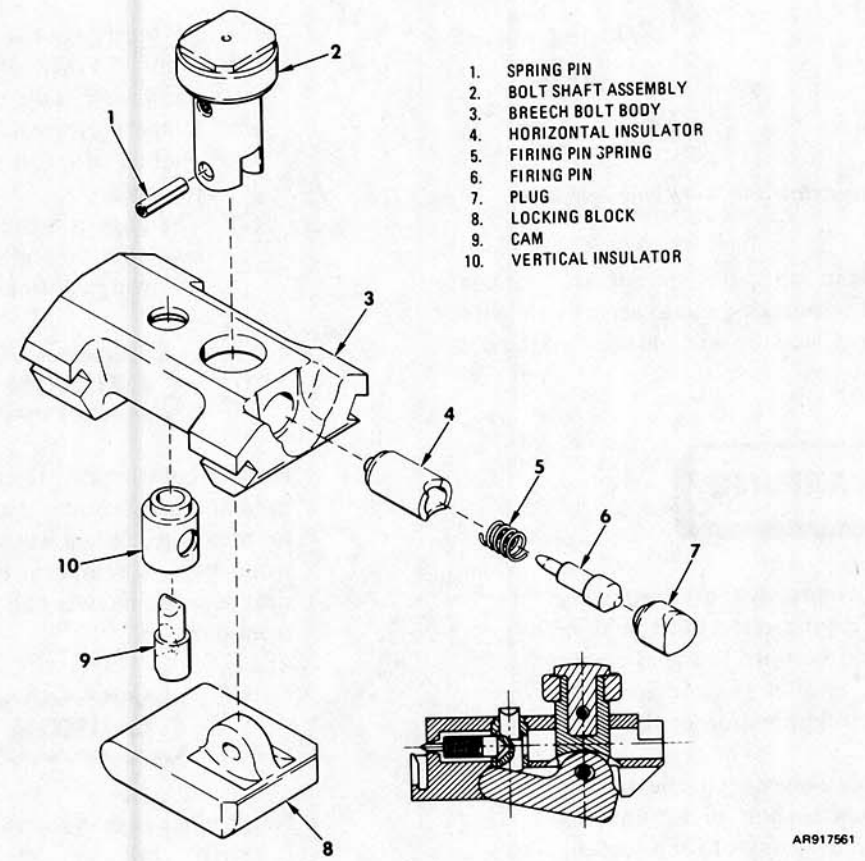


Figure 3-24.1 Breech Bolt — Exploded View

(3) As drift is withdrawn, plug (7), firing pin (6), and firing pin spring (5) will be ejected from horizontal insulator (4) in breech bolt body.

(4) Apply slight inward pressure on vertical insulator (10) to force vertical insulator out of breech bolt body.

(5) Tap aft face of breech bolt body sharply on a wooden block to dislodge horizontal insulator (4) from breech bolt body. Remove horizontal insulator.

e. *Indexing Pin.*

(1) Drive out spring pin (5, fig. 3-25) securing knob (4) to index pin (1). Remove knob.

(2) Remove spring (3), and bushing nut (2) from index pin.

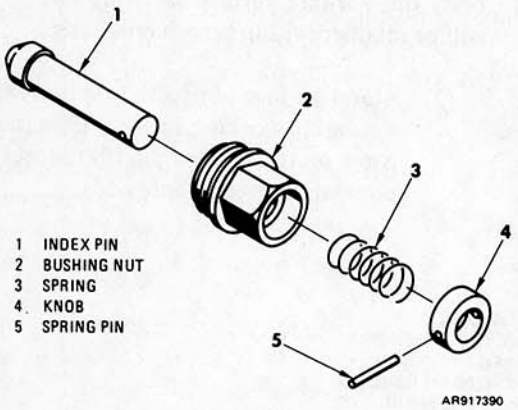


Figure 3-25. Indexing Pin — Exploded View

3-30. Cleaning. Clean all parts except the muzzle clamp plate bolt and self-locking nut in accordance with paragraph 3-5b and c. Clean the bolt and self-locking nut as follows:

WARNING

Cleaning solvents evaporate quickly and have a drying effect on the skin. Gloves should be worn to avoid cracks in the skin, and in some cases mild irritation or inflammation of the skin.

Do not apply solvents, lubricants, or wetting agents to bolt or self-locking nut to avoid loss of self-locking capability.

a. Buff threads of bolt with a dry wire brush and wipe threads clean.

b. Buff threads of self-locking nut with a dry, non-metallic brush and wipe threads clean.

3-31. Inspection.

a. All parts will be visually inspected and repaired or replaced if found to be defective. Parts will be cleaned prior to inspection in order to effectively accomplish a complete inspection.

b. Table 3-12 lists gun components and possible defects at specified points on the component to assist in accomplishing the visual inspections.

c. Bore erosion in a barrel causes a loss in muzzle velocity. When bore erosion exceeds the limits given in step (1) below the barrel will be replaced.

WARNING

To avoid injury to personnel or damage to gage, do not check a hot barrel. Incorrect readings will result if barrel is hot and the collet may seize the bore.

(1) All bore gage readings will be taken at a point 55.5 inches from the muzzle end of the barrel with the barrel at ambient temperature. Any barrel having a gage reading of 0.050 inch or greater will be replaced.

(2) The gage is a precision instrument and must be handled with care. The following cautions will be observed:

CAUTION

Handle collet with extreme care. It is hard and brittle and is therefore subject to breakage. When stowing gage, or while gage is temporarily not in use, slide setting ring over collet to protect it from damage.

CAUTION

Never place gage in such a position that it might fall or be stepped on accidentally.

CAUTION

Do not remove spring pin from gage tube. It is a safety device which keeps other gage components from accidentally sliding off the rod.

(3) Check barrel for bore erosion as follows:
- (a) Clear gun and clean bore of barrel thoroughly. Visually inspect bore using a suitable light source or by means of a cleaning patch or piece of white paper inserted into breech opening to reflect light into the bore.
- (b) Carefully inspect area to be gaged (55.5 inches from muzzle end). Make certain there is no obstruction in the bore which might cause an incorrect gage reading.
- (c) Remove bore erosion gage from storage box, assemble, and zero gage. Set gage stop (fig. 3-26) so that station calibration (55.5 inches) is aligned with muzzle face index mark on stop. Tighten collar stop.
- (d) Insert gage into bore, moving it forward until gage stop is against face of muzzle (fig. 3-27).
- (e) Support gage to keep it aligned with bore and gently move calibrated rod forward until collet is fully expanded against bore. Avoid excessive forward movement which may indent rod.
- (f) Read gage by noting rod calibration aligned with aft end of indicator. Replace barrel if the reading is 0.050 inch or greater.
- (g) Retract calibrated rod and remove gage from bore. Clean gage and place it in storage box.
- (h) Bore erosion to be checked every 1500 rounds after an erosion of 0.035 inch has been indicated. Restrict burst length on barrels with 0.035 inch of erosion to less than 300 rounds in any 5-minute period.

3-32. Repair.

a. *General.* Repair of gun parts consists of replacement of defective parts and/or parts scheduled for replacement according to rounds interval replacement requirements.

b. *Repair after Firing Stoppage.* The following special information for repair after firing stoppage is applicable to specific components of the gun. Operation of these components is critical to gun operation and requires special consideration before the component is repaired and returned to service.

(1) *Gun housing.* If any firing has occurred with a breech bolt out of locked position, the gun housing may be warped and unserviceable. Special tooling is required to check for this condition. If there is any question as to the serviceability of the gun housing, return entire M197 gun to next higher maintenance level for repair.

(2) *Breech bolt.* Replace any breech bolt which was involved in, or the cause of, a sudden firing stoppage. In many cases, the roller shaft will be sheared or the bolt body damaged. Replace locking and unlocking cams that have been damaged in any way. Unlocking cams shall be replaced as a set. The use of one new and one used part is not authorized.

(3) *Guide bar.* The guide bar is usually bent during a misfeed or backup of spent cases. Evidence of a defective guide bar

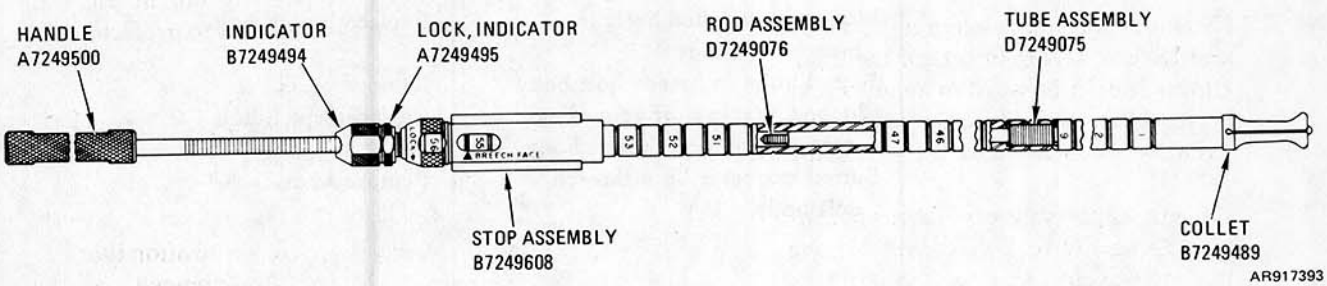


Figure 3-26. Gage Station Calibration

Table 3-12. M197 Gun — Parts Inspection

Component	Possible Defect	Remedy
Barrels	Damaged locking lugs or flanges	Replace barrel.
	Cracks, bulges, visible internal pitting or erosion. (Erosion is the result of gas cutting and is visually identified by irregular lengthwise grooves just forward of the case neck area.) Bore erosion shall not exceed 0.050 inch (see paragraph 3-31c). Loss of chrome plating forward of chamber is permissible.	Replace barrel.
	Loss of chrome plating in chamber.	Replace barrel.
Breech bolts	Bolt shaft roller damaged; does not rotate freely on bolt shaft.	Replace bolt shaft assembly.
	Burred bolt shaft	Remove burrs.
	Bent or galled bolt shaft	Replace bolt shaft assembly.
	Cracked or spread bolt shaft forks	Replace bolt shaft assembly.
	Burred locking block lug	Remove burrs.
	Cracked locking block lug	Replace locking block.
	Worn (peened over tip) bent, cracked, or broken firing pin	Replace firing pin.
	Deformed or cracked firing pin insulator	Replace firing pin insulator.
	Deformed or cracked horizontal insulator	Replace horizontal insulator.
	Kinked or broken firing pin spring	Replace firing pin spring.
	Cracked or deformed insulation on contact stop	Replace contact stop.
	Missing small projection on contact stop	Replace contact stop.
	Deformed plug	Replace plug.
	Chipped, galled, or bent firing pin cam	Replace firing pin cam.
	Chipped, galled, or bent cam pin	Replace cam pin.
	Deformed or cracked firing pin cam insulator	Replace firing pin cam insulator.
	Deformed vertical insulator	Replace vertical insulator.
	Elongated or galled holes in breech bolt body	Replace breech bolt.
	Burred holes in breech bolt body	Remove burrs.
	Chipped, cracked, or gouged extractor lip in breech bolt body	Replace breech bolt.
	Burred extractor lip in breech bolt body	Remove burrs.

Table 3-12. M197 Gun — Parts Inspection — Continued

Component	Possible Defect	Remedy
Breech bolts - cont.	Bolt shaft assembly and locking block do not function freely	Replace locking block and bolt shaft assembly. If problem still exists, remove new locking block and bolt shaft assembly and retain for reuse. Replace breech bolt.
Mid-barrel clamp	Bent or damaged locking lugs on clamp plate. Acceptable lug width is 0.46 to 0.49 inch.	Mid-barrel clamp is serviceable if it can be easily installed and locking lugs are within limits. Replace mid-barrel clamp if it cannot be easily installed or locking lugs are not within limits.
	Distorted or cracked clamp plate or locking disc	Replace mid-barrel clamp.
	Missing locking disc spring pin	Replace spring pin.
	Missing retaining ring	Replace retaining ring.
	Missing locking lugs	Replace mid-barrel clamp.
Muzzle clamp plate and associated parts	Cracked or damaged clamp plate	Replace clamp plate.
	Distorted or dished self-locking nut	Replace bolt and self-locking nut.
	Locking feature of self-locking nut not functioning. Check is performed during installation of muzzle clamp plate	Replace bolt and self-locking nut if requirements of paragraph 3-33e. (32.2) are not met.
	Stripped threads on bolt	Replace bolt and self-locking nut if breakaway torque is less than 90 lb-in.
	Missing self-locking nut retaining pin	Replace bolt and self-locking nut.
Front unlocking cam	Cracked front unlocking cam	Replace both front and rear unlocking cams.
Rear unlocking cam	Cracked rear unlocking cam	Replace both front and rear unlocking cams.
Indexing pin	Damaged or bent index pin	Replace index pin if it binds.
	Broken spring	Replace spring.
Coupling clamp	Bent or cracked coupling clamp	Replace coupling clamp.
Firing contact	Loose insert in contact cam	Replace contact cam.
	Excessive wear or damage to bottom of contact cam (fig. 3-28)	Replace contact cam.
	Elongated spring pin hole in contact cam	Replace contact cam.
	Broken or weak contact cam springs	Replace contact cam springs.

Table 3-12. M197 Gun — Parts Inspection — Continued

Component	Possible Defect	Remedy
Firing contact - cont.	Damaged or cracked firing contact support	Replace firing contact support.
	Elongated spring pin holes in contact cam mounting lugs on firing contact support. Acceptable hole diameter is 0.094 to 0.099 inch.	Replace firing contact support.
	Bent contact cam mounting lugs on firing contact support. Acceptable width between mounting lugs is 0.310 to 0.318 inch.	Bend to dimension. Replace if functionally impaired.
	Cracked connector	Replace firing contact.
	Cracked or broken potting compound	Replace firing contact.
	Broken or damaged conductor	Replace firing contact.
	Short circuit (continuity) between pin in connector and body of connector. Check with conductor removed from insert in contact cam.	Clean foreign material from connector. Replace firing contact.
	Open circuit (no continuity) between pin in connector and insert face on bottom of contact cam. Check that conductor is installed in insert in contact cam.If open circuit is obtained and conductor is installed in insert, remove conductor from insert; then, check for open circuit between pin in connector and bare end of conductor and for open circuit between insert inside of contact cam and contact on bottom of contact cam	If necessary, install conductor in insert of contact cam. If connector is defective, replace firing contact. Replace contact cam if defective.
Guide bar	Elongated mounting holes (fig. 3-29)	Replace guide bar.
	Bent body or fingers	Replace guide bar.
	Fingers not parallel to each other and perpendicular to body of guide bar	Replace guide bar.
	Missing finger(s)	Replace guide bar.
	Cracked	Replace guide bar.

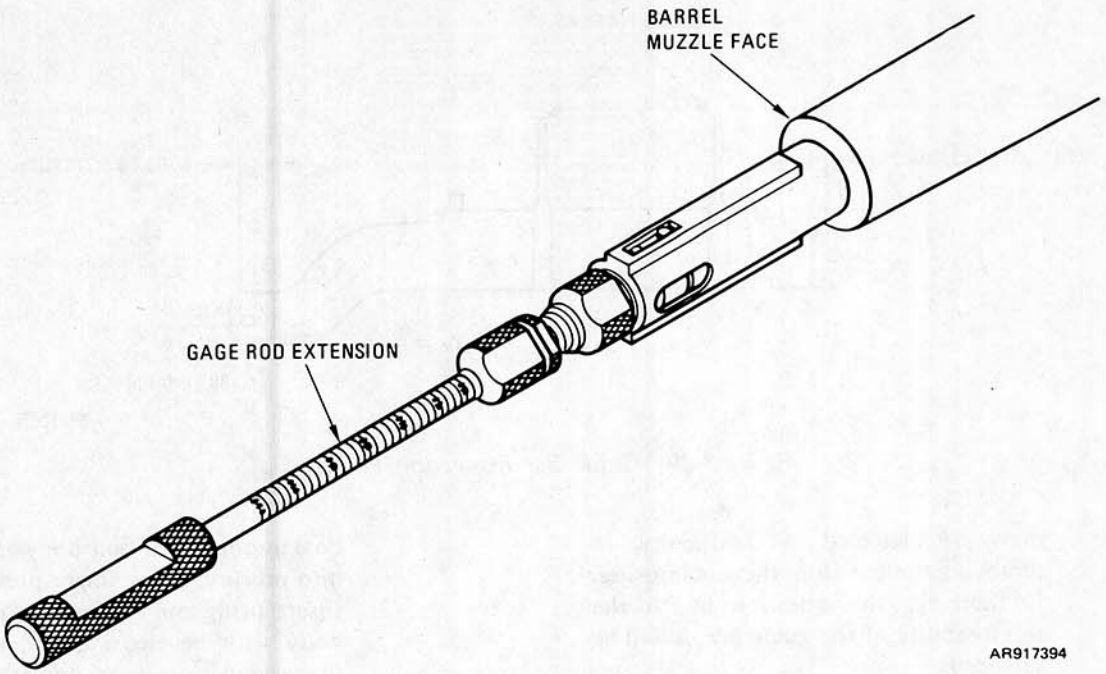


Figure 3-27. Gage Stop Positioned Against Face of Muzzle

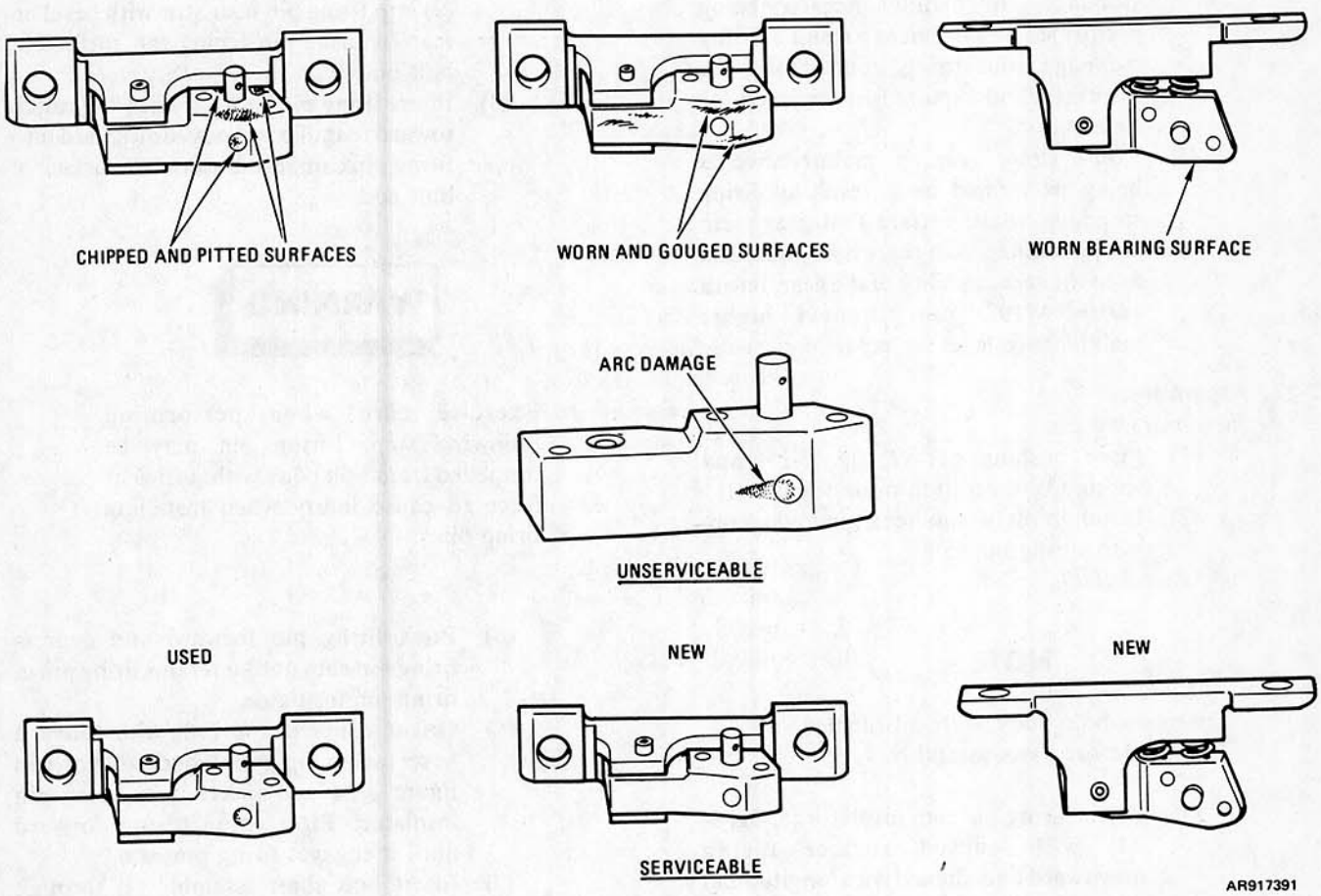


Figure 3-28. Contact Cam Inspection Points

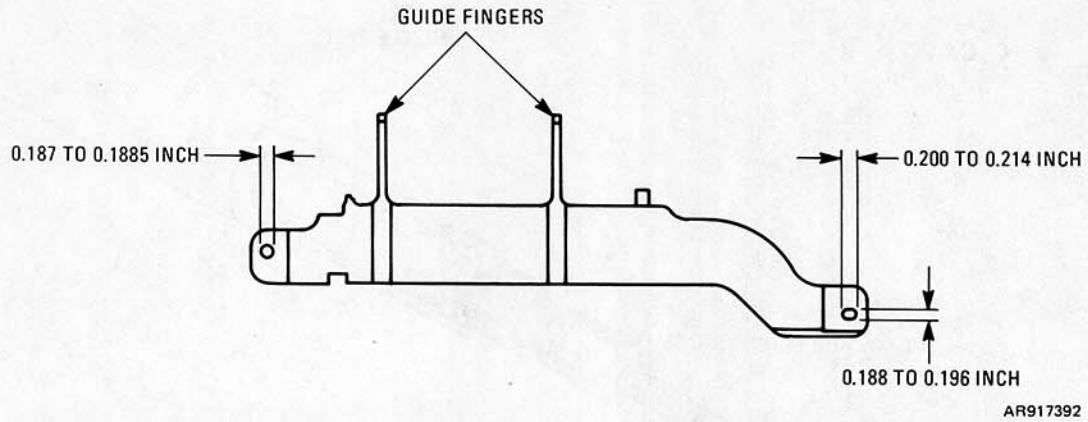


Figure 3-29. Guide Bar Inspection Points

may be detected by difficulty in removing the bar from the gun housing. If there is any question as to the serviceability of the guide bar, it will be replaced.

(4) *Firing contact.* The firing contact is vulnerable to damage during firing stoppage. If maintenance is being performed on the gun as a result of firing stoppage, the firing contact will be inspected and repaired or replaced, as necessary.

(5) *Rotor drive gear.* If maintenance is being performed as a result of firing stoppage, make certain that gear teeth are not damaged. If there is any question as to the serviceability of the gear, return entire M197 gun to next higher maintenance level for repair.

3-33. Assembly.

a. *Indexing Pin.*

(1) Place bushing nut (2, fig. 3-25) and spring (3) in position on index pin (1).

(2) Install knob (4) on index pin and secure with spring pin (5).

b. *Breech Bolt.*

NOTE

Lubricate bolt body with oil (item 3, App D) before parts assembly.

(1) Orient firing pin cam insulator (5, fig. 3-24) with curved surface facing downward and aligned with longitudinal axis of bolt body (4) as shown in figure 3-24. Insert firing pin cam insulator into hole in bottom of bolt body and press it into position using finger pressure.

(2) Insert firing pin insulator (7) into bolt body with beveled surface on rear of firing pin insulator toward bottom surface of bolt body.

(3) Insert firing pin spring (8) and firing pin (9) into firing pin insulator with bevel on rear of firing pin facing top surface of bolt body.

(4) Insert firing pin cam (3), with "V" notch toward rear of bolt body, downward into firing pin cam insulator in top surface of bolt body.

WARNING

Exercise care when performing following step. Firing pin may be propelled from bolt body with sufficient force to cause injury when installing firing pin.

(5) Press firing pin forward and depress firing pin cam until it retains firing pin in firing pin insulator.

(6) Orient contact stop (10) with forward bevel facing top of bolt body as shown in figure 3-24 and insert it in firing pin insulator. Push contact stop forward until it engages firing pin cam.

(7) Insert bolt shaft assembly (1) through bolt body and place locking block (6) in position on bolt body.

CAUTION

Make certain that the spring pin is a drive fit in the bolt shaft assembly. If the spring pin hole is oversize and/or the spring pin is undersize, the spring pin could vibrate out of the shaft during firing and cause a gun jam.

(8) Align spring pin hole in locking block with corresponding holes in bolt shaft assembly and install spring pin (2). Drive pin into place so that ends are equidistant from surface of bolt shaft assembly.

(9) With locking block in locked position (down) and firing pin cam fully depressed, check firing pin protrusion. Firing pin protrusion from front face of bolt body shall be from 0.033 to 0.048 inch inclusive.

(10) Perform breech bolt firing circuit test as follows:

(a) Depress bolt shaft as shown in inset A of figure 3-30. With firing cam pin depressed approximately 1/16 inch, check that there is no short circuit between firing cam pin and breech bolt body (see fig. 3-30). Multimeter should indicate an open circuit (no meter needle movement).

(b) Depress bolt shaft as shown in inset A of figure 3-30. With firing cam pin depressed approximately 1/16 inch, check continuity between firing cam pin and firing pin (see fig. 3-30). Multimeter should indicate continuity.

b.1 *Breech Bolt.*

NOTE

Lubricate breech bolt body with oil (item 3, App D) before parts assembly.

(1) Orient horizontal insulator (4, fig. 3-24.1) with curved surface aligned with vertical axis of breech bolt body (3) as shown in figure 3-24.1. Insert horizontal insulator into breech bolt body.

(2) Orient vertical insulator (10) so that hole through horizontal axis of insulator is aligned with longitudinal axis of breech bolt body as shown in figure 3-24.1. Insert vertical insulator into breech bolt body.

(3) Insert firing pin spring (5) and firing pin (6) into horizontal insulator.

(4) Insert cam pin (9) upward into vertical insulator (10) with countersink in cam pin facing front of breech bolt body.

WARNING

Exercise care when performing following step. Firing pin may be propelled from breech bolt body with sufficient force to cause injury.

(5) Using a drift, press firing pin forward until cam pin can be pushed past end of firing pin. Withdraw drift while pushing cam pin fully into position so that aft end of firing pin is seated in countersink in cam pin.

(6) Insert plug (7) into breech bolt body with bevels on rear of plug facing top and bottom surfaces of breech bolt body. Push plug forward until tip of plug enters hole in vertical insulator.

(7) Insert bolt shaft assembly (2) through breech bolt body and place locking block (8) in position on breech bolt body.

CAUTION

Make certain that spring pin is a drive fit in bolt shaft assembly. If spring pin hole is oversize and/or spring pin is undersize, spring pin could vibrate out of shaft during firing and cause a gun jam.

(8) Align spring pin hole in locking block lug with corresponding holes in bolt shaft assembly and install spring pin (1). Drive spring pin into place so that ends are equidistant from surface of bolt shaft assembly.

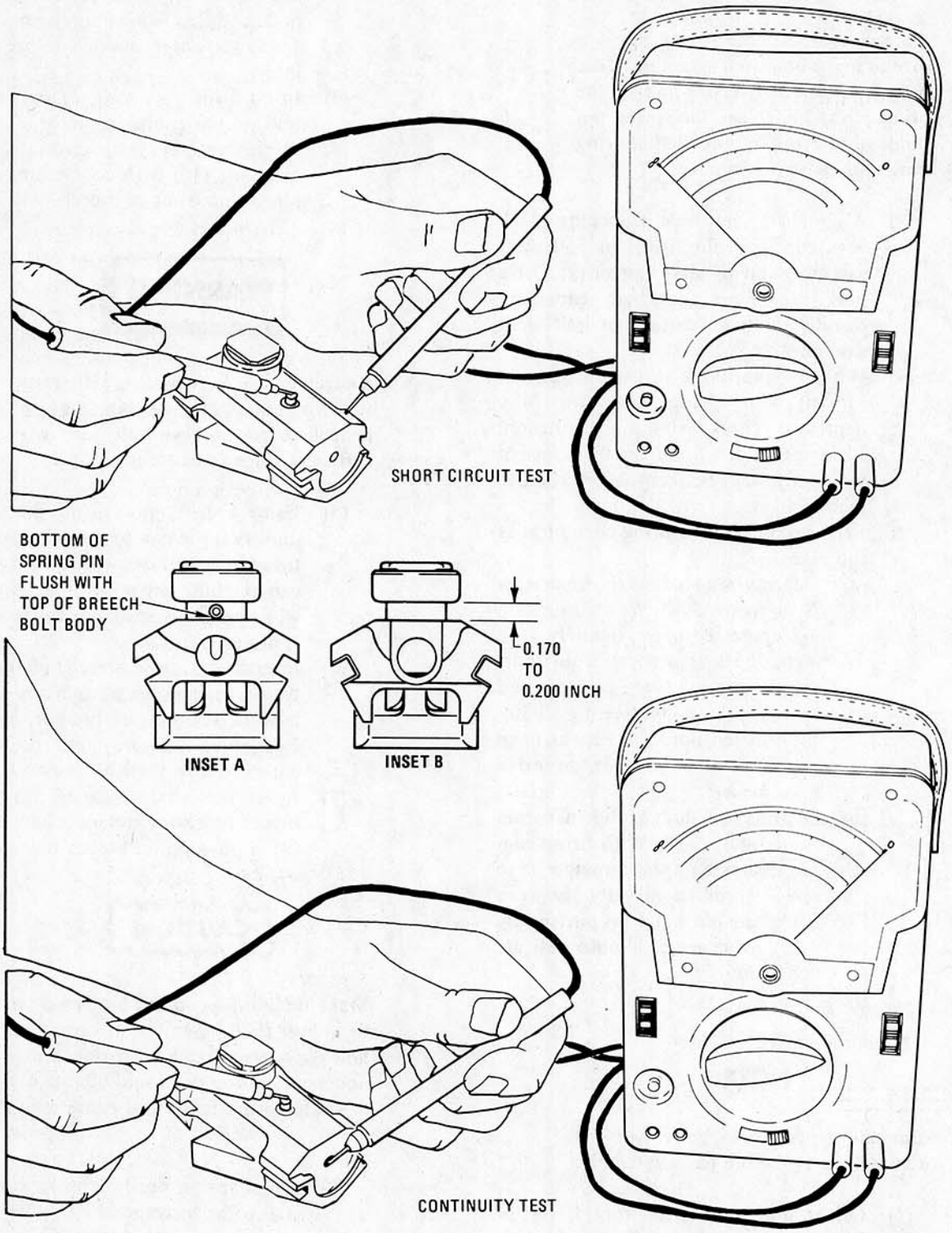


Figure 3-30. Testing a Breech Bolt

(9) With locking block in locked position (bolt shaft assembly depressed as shown in inset B of figure 3-30) and cam pin fully depressed, check firing pin protrusion. Firing pin protrusion from front face of breech bolt body shall be 0.036 inch minimum.

(10) With locking block in unlocked position (up maximum) and cam pin depressed to maximum (cam pin against locking block), firing pin shall not protrude beyond front face of breech bolt body.

(11) Perform breech bolt firing circuit test as follows:

NOTE

When performing following step, plastic shim or other suitable insulating material may be used to prevent contact between cam pin and locking block to avoid a false short circuit indication.

(a) With locking block in locked position (bolt shaft assembly depressed as shown in inset B of figure 3-30) and cam pin depressed 0.060 to 0.080 inch, check that there is no short circuit between cam pin and breech bolt body (see fig. 3-30). Multimeter should indicate an open circuit (no meter needle movement).

(b) With locking block in locked position (bolt shaft assembly depressed as shown in inset B of figure 3-30) and cam pin depressed 0.060 to 0.080 inch, check continuity between cam pin and firing pin (see fig. 3-30). Multimeter should indicate continuity.

c. *Firing Contact.*

(1) Insert two contact cam springs (3, fig. 3-23) into holes in contact cam (4).

(2) Position contact cam, with springs in place, in approximate mounting position on firing contact support (2).

(3) Align spring pin hole in contact cam with corresponding holes in firing contact support and install spring pin (6).

(4) Drive pin into place so that ends are equidistant from surface of firing contact support.

(5) Measure distance between mounting surface of firing contact support and contact surface of firing cam assembly as shown in figure 3-31. Make certain distance is within limits of 0.806 and 0.840 inch inclusive.

(6) Orient connector bracket (1, fig. 3-23) and firing contact support (2) as shown in figure 3-23; then, carefully push bare end of conductor (7) through hole in

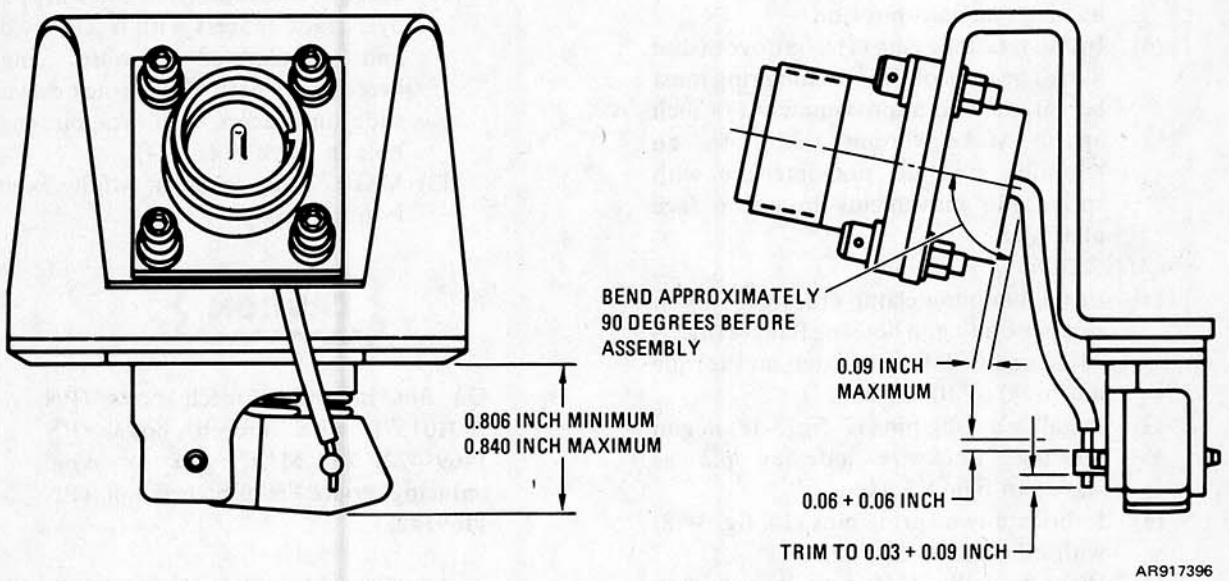


Figure 3-31. Firing Contact — Assembly Details

insert (5) and join connector bracket and firing contact support in appropriate position for installation.

(7) Bend conductor away from connector and adjust position of bare end of conductor in insert as shown in figure 3-31.

(8) Perform firing contact continuity and short circuit test as follows:

(a) Check continuity between connector pin and firing cam insert as shown in figure 3-32. Multimeter will indicate continuity.

(b) Check for short circuit between connector bracket and firing cam insert. Multimeter will not indicate continuity.

d. *Mid-Barrel Clamp.*

(1) Insert spring pin (3, fig. 3-22) in hole aligned with center of lock tab on hub side of locking disc (4) and drive into disc until pin is flush with rear disc face +0.03 inch.

(2) Insert three helical compression springs (5) into holes in locking disc hub and insert a detent plunger (6) on top of each spring.

(3) Position plate and locking disc so spring pin (3) is aligned within milled slot in plate and detent grooves in bore of plate are aligned with detent plunger positions in locking disc.

(4) Depress detent plungers and insert locking disc hub into bore of plate. Press locking disc into position.

(5) Install retaining ring (1) in groove in disc hub. The ends of the retaining ring must be parallel and approximately 1/8 inch apart. Make certain that tabs on retaining ring do not interfere with spring pin movements in clamp face plate slot.

e. *M197 Gun*

(1) Install coupling clamp (16, fig. 3-18) on end plate and gun housing flanges (fig. 3-33). Engage T-bolt in latch and torque nut to 90 to 100 lb-in.

(2) Install indexing pin (17, fig. 3-18) in gun housing. Lockwire indexing pin as shown in figure 3-34.

(3) Lubricate two spring pins (14, fig. 3-18) with oil (item 3, App D).

(4) Place guide bar (15) in position on gun housing, align mounting holes, and secure with two spring pins (14).

CAUTION

Front and rear unlocking cams are installed in pairs. The use of one new and one used part is not authorized.

(5) Place front unlocking cam (10) in position on rear housing.

(6) Apply pressure to hold front unlocking cam against rear housing at critical contact area shown in figure 3-35 and install bolts (10, fig. 3-18).

(7) Torque bolts to 250 to 300 lb-in.

(8) Place rear unlocking cam (7) in position on rear housing.

(9) Apply pressure to hold rear unlocking cam against rear housing at critical contact area shown in figure 3-35 and install bolts (8, fig. 3-18).

(10) Torque bolts to 250 to 300 lb-in.

NOTE

This procedure assumes removable rotor tracks are not installed in rotor. If necessary, remove tracks as required to accomplish breech bolt installation.

(11) Turn rotor in direction of gun rotation until a track rib with springs appears in gun housing cutout.

(12) Place a removable rotor track in position over track spacers with track key down and extended edge toward center of breech bolt path. Press track down and slide on spacers until lock pin engages hole in track (fig. 3-21).

(13) Make certain lock pin is fully extended in track hole.

CAUTION

Do not intermix breech bolts (PN 10010157) with breech bolts (PN 11691422) in M197 gun to avoid reducing service life of breech bolts (PN 11691422).

(14) Place a breech bolt in rear well and slide it forward until breech bolt is positioned on center rotor tracks.

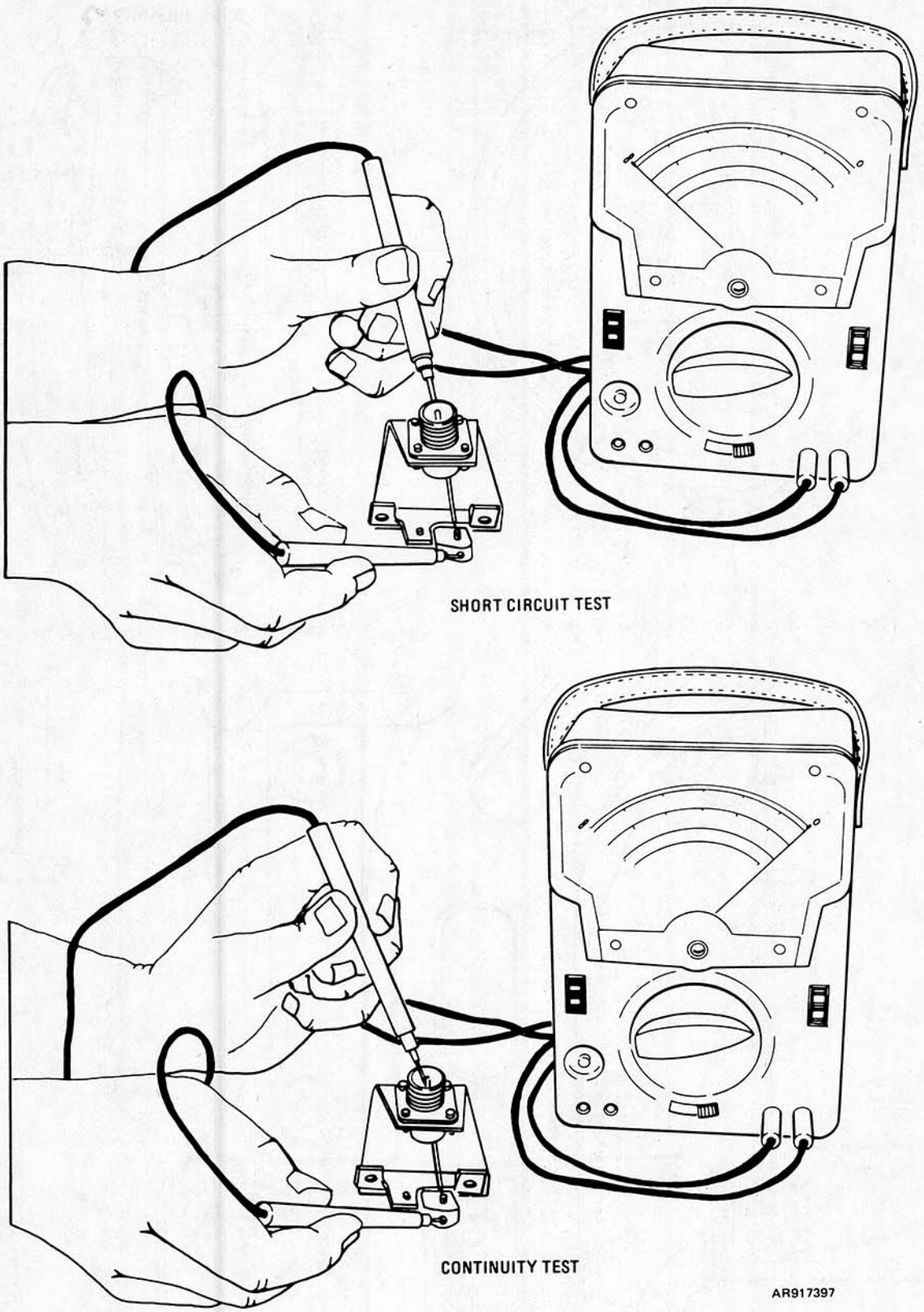


Figure 3-32. Testing Firing Contact

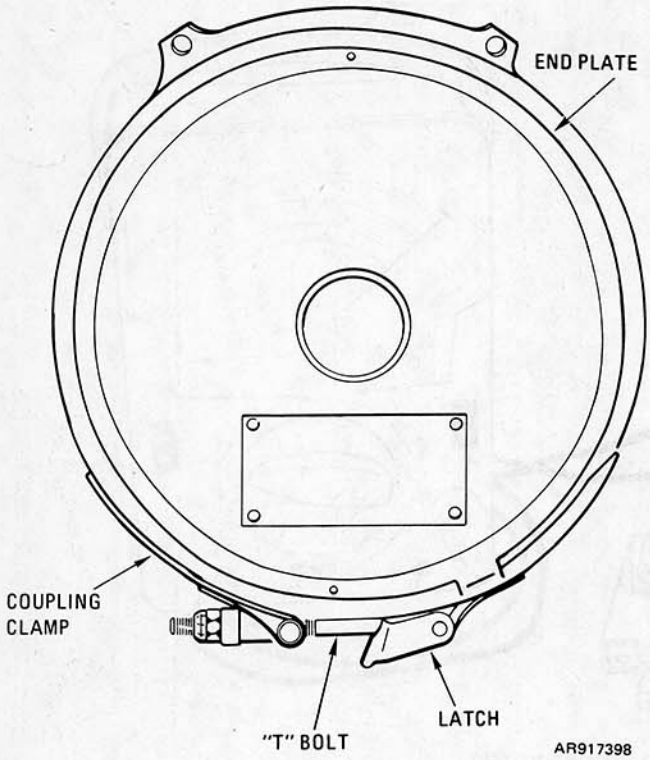


Figure 3-33. Installing Coupling Clamp

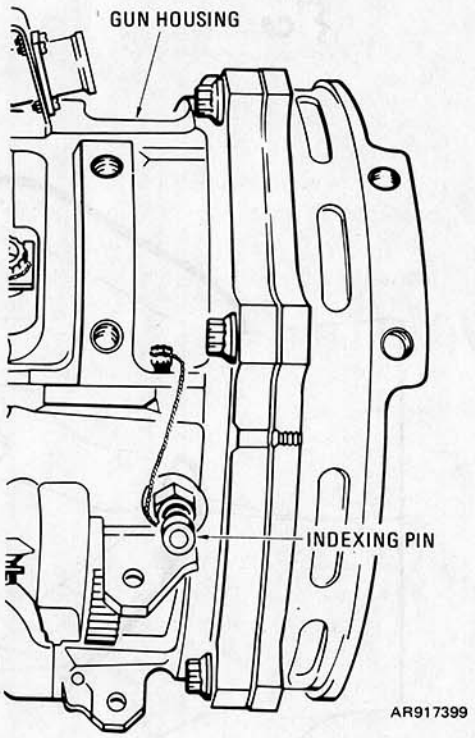


Figure 3-34. Lockwiring Indexing Pin

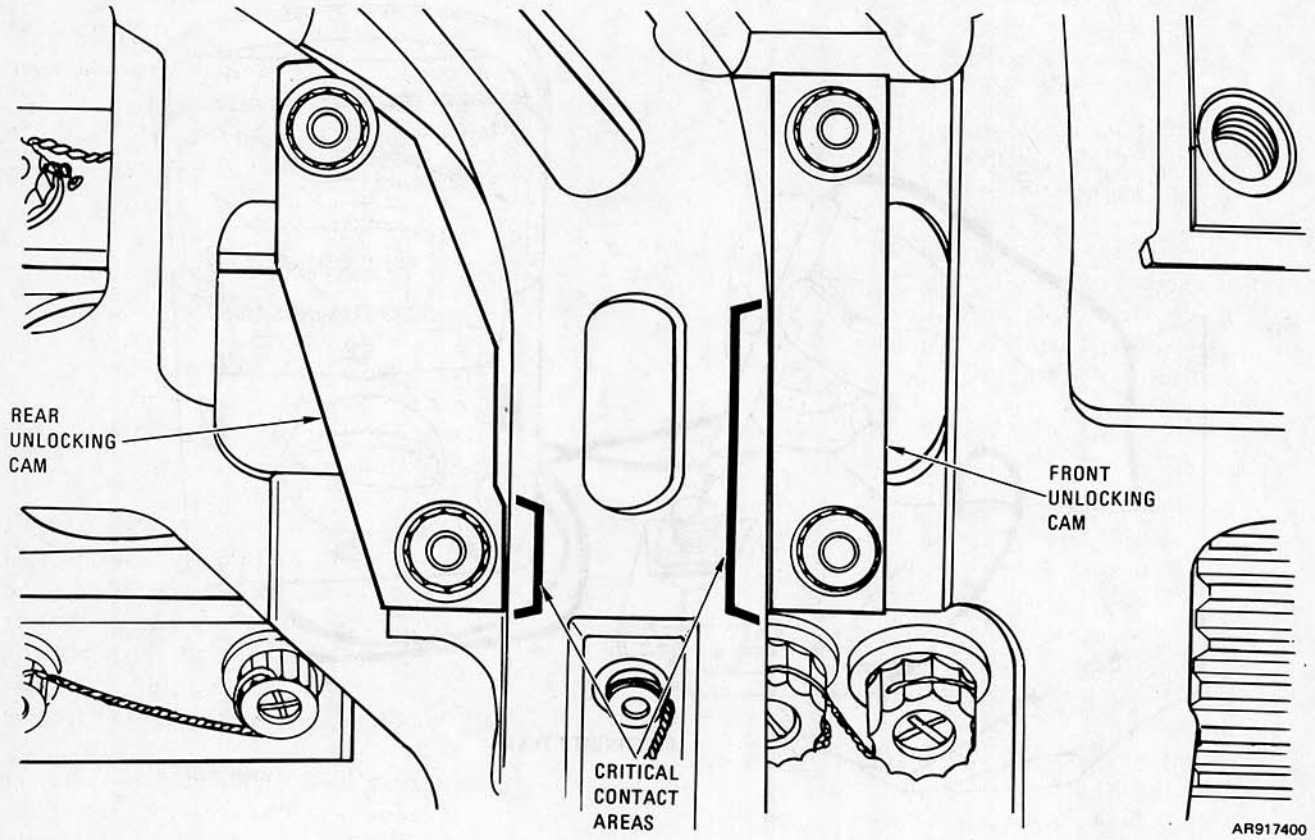


Figure 3-35. Front and Rear Unlocking Cams — Critical Contact Areas

CAUTION

The breech bolt must be secured in place by two tracks before rotor is turned for the next bolt installation to prevent breech bolt jamming in gun housing. Use caution during installation to assure two breech bolts are not installed on same set of tracks. This condition will require separation of gun housing bodies to remove extra breech bolt.

(15) Install a second removable rotor track on the other track rib.
(16) Slide breech bolt to rear and position on removable rotor tracks.
(17) While pressing down on bolt shaft, turn rotor in direction of gun rotation to engage breech bolt in clearing cam path. Continue turning rotor until track rib for second breech bolt installation appears in gun housing cutout.
(18) Repeat steps (11) through (17) above until all breech bolts have been installed.
(19) Cycle gun a minimum of one revolution to assure breech bolts do not bind in main cam path.

CAUTION

The firing contact support and connector bracket are separate assemblies. Use caution during installation; damage to the electrical conductor may occur if the two are separated.

(20) Set firing contact (11, fig. 3-18) in mounting position on gun housing with front edge of firing contact support in contact with gun housing cutout and held laterally toward direction of gun rotation.
(21) Lubricate threads of mounting screws (12) with oil (item 3, App D) and install through firing contact mount holes into gun housing. Torque screws (12) to 23 to 32 lb-in.
(22) Lockwire screws as shown in figure 3-36.
(23) Install barrel (13, fig. 3-18) in rotor with interrupted locking lugs on barrel

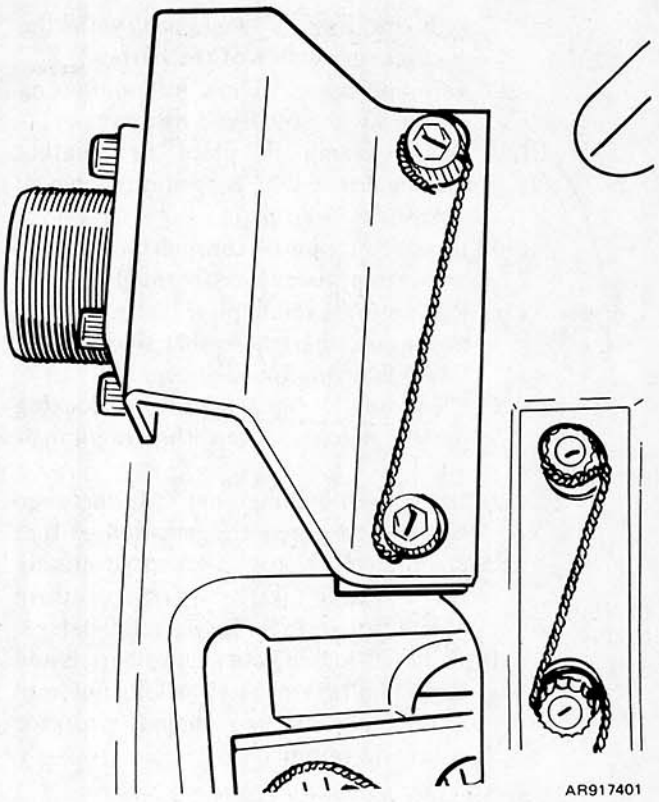


Figure 3-36. Lockwiring Firing Contact

aligned with cleared area between locking lugs in rotor.
(24) Rotate barrel approximately 60° in either direction to lock in place.

WARNING

Improper installation of barrels could allow barrel cluster to separate from gun and result in injury to personnel and damage to equipment.

(25) After installing first barrel, inspect empty holes on either side of installed barrel for presence of locking lugs and visual indication of breech bolts. If either condition exists, barrel is installed in hole without locking lugs. Remove barrel and install it in a hole with locking lugs.
(26) Repeat steps (23) and (24) above for remaining two barrels.
(27) Slide mid-barrel clamp (5) on barrels. Place in approximate mounting position

with locating tabs aligned with the grooves on outside of the barrels.

(28) Tap mid-barrel clamp into mounting position with soft-faced hammer.

(29) Secure clamp in place by rotating locking disc to LOCK position shown by arrow on clamp plate.

(30) Install cotter pin (4) through locking disc and clamp plate. (See fig. 3-10.)

(31) Place muzzle clamp plate (2, fig. 3-18) in position on barrels so that side marked FWD is facing forward (fig. 3-9).

(31.1) Clean bolt (1, fig. 3-18) and self-locking nut (3) in accordance with paragraph 3-30.

(32) Insert self-locking nut (3) between barrels and place it in position so that chamfered surfaces of barrel cutouts are in contact with corresponding chamfered surfaces on barrel collars.

(32.1) Hold self-locking nut against barrels and thread bolt (1) into self-locking nut until a minimum of two threads protrude from end of nut.

CAUTION

When performing following steps, a suitable device, such as a bar or a screwdriver, should be placed directly behind muzzle clamp to prevent barrel cluster distortion.

(32.2) Restrain barrel cluster and, using a torque wrench, turn bolt slowly. If torque required to turn bolt is less than 90 lb-in., replace bolt and self-locking nut.

(33) Torque bolt to 750 to 950 lb-in.

3-34. M197 Gun Post Assembly Checkout.

a. *Gun Torque Check.* Check the torque required to rotate an empty gun (M89E1 feeder and gun drive not installed) as follows:

(1) Place a torque wrench on muzzle clamp bolt and rotate mechanism clockwise as viewed from barrel end. Observe average dynamic torque reading, not initial starting torque.

(2) Torque readings in excess of 100 lb-in. usually indicate worn parts, improper assembly, or lack of lubrication. Refer to paragraph 3-9 troubleshooting instructions to check and correct causes of high torque.

b. *Mechanical Check.* Perform the following procedure using three dummy rounds.

WARNING

Exercise extreme care when hand feeding dummy rounds. Support rounds very lightly with finger tips and do not place fingers between rounds and rotor in direction of rotation.

CAUTION

Exercise care when performing following steps making sure that dummy rounds do not enter gun in front of extractor lips of breech bolts and jam gun. A jammed gun will have to be disassembled to remove rounds.

(1) Carefully reach in through opening on feeder side of guide bar and place a dummy round in breech bolt, engaging rim of round in extractor lip. Turn gun slightly in firing direction until round is supported by gun housing fingers. Withdraw hand before rotating gun further.

CAUTION

Do not reverse direction of rotation or gun will be damaged when firing pin cam is forced against firing contact; and a bolt locking block will jam in front locking well of rotor.

(2) Rotate mechanism. Dummy round should chamber, extract, and eject. No marks other than normal wear marks will appear on the ejected round.

(3) Hand feed three dummy rounds consecutively to fill all chambers. Rotate mechanism until all rounds have been

ejected. Check all rounds for marks other than normal sliding wear.

(4) Eliminate any malfunction by repair or replacement of defective part(s). Refer to troubleshooting instructions.

3-35. Installation.

a. Install recoil attenuation system (para 3-45).

b. Apply a light coating of grease (item 2, App D) to rear mount on saddle.

WARNING

Keep fingers clear of gun rotor, breech bolts, and other movable parts. Rear of gun must be supported by non-rotating, non-reciprocation area to avoid injury to hands/fingers if barrel cluster is accidentally rotated.

NOTE

Prior to performing following step, rotate recoil adapter shaft and slider shaft to match saddle lugs.

c. Engage elevation drive motor brake. Using two men, engage aft end of M197 gun in rear mount and position M197 gun in saddle by engaging recoil adapter in narrow saddle lug first and then engaging slider in wide saddle lug. Secure M197 gun in place with two quick-release pins (fig. 3-37). Secure bails of quick-release pins to saddle with cable straps (MS3367 or equivalent) as shown in figure 3-37.

WARNING

Improper installation of barrels could allow barrel cluster to separate from M197 gun and result in injury to personnel or damage to equipment. Inspect empty holes on either side of installed barrels for presence of locking lugs and visual indication of breech bolts. If either condition exists, barrels are improperly installed. Remove barrels and install them in holes with locking lugs.

d. Install gun drive (para 3-40).

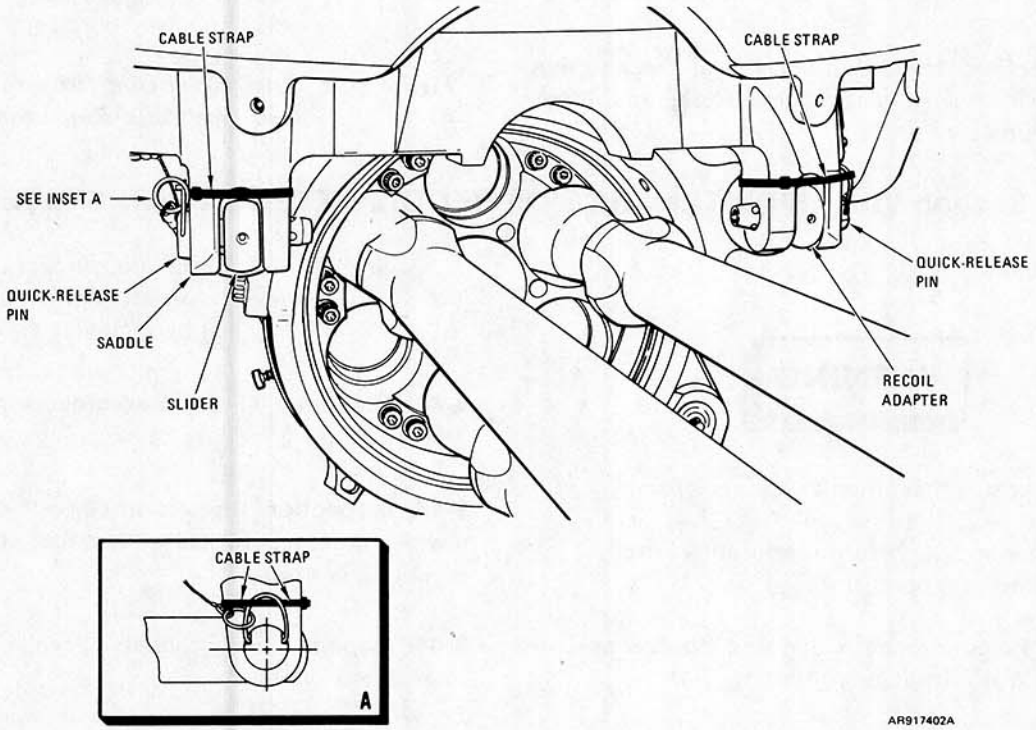


Figure 3-37. Forward Gun Mounts

d.1 Connect connector W2P3 to M197 gun and lockwire. See figure 3-38 for lockwiring details.

e. Install feeder (para 3-25).
e.1 Deleted.
f. Perform system checkout (table 3-5).

Section VII. MAINTENANCE OF GUN DRIVE

3-36. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

a. Remove lockwire and disconnect connector W3P8 (fig. 3-4) from gun drive.
b. Remove three of four mounting bolts securing gun drive (11, fig. 3-3) to gun. Do not remove upper left mounting bolt at this time.
c. While supporting gun drive, remove remaining mounting bolt and remove gun drive.

3-37. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-38. Inspection. Inspection consists of checking for sheared shear pins, damaged gear teeth, and loose mounting hardware.

3-39. Repair. Repair consists of replacement of gun drive.

3-40. Installation.

a. Place gun drive (11, fig. 3-3) in position on gun and secure with four bolts.
b. Connect connector W3P8 (fig. 3-4) to gun drive and lockwire. See figure 3-38 for lockwiring details.
c. Connect W2P1 at aft end of saddle.

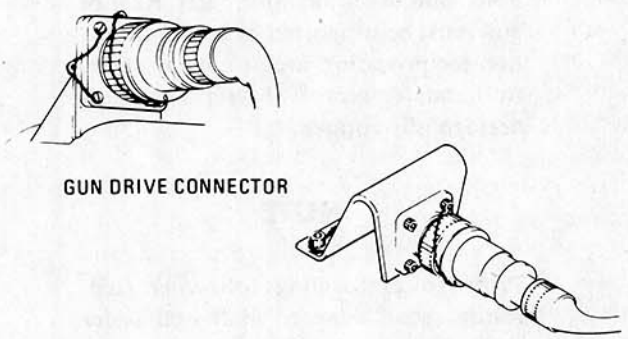


Figure 3-38. Lockwiring Gun Drive Connector and Gun Fire Volts Connector

Section VIII. MAINTENANCE OF RECOIL ATTENUATION SYSTEM

3-41. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

a. Remove lockwire and disconnect connector W3P8 from gun drive (fig. 3-4).
b. Remove feeder and gun (para 3-19 and 3-28).
c. Remove recoil attenuation system (12 and 15, fig. 3-3) by removing eight bolts.

3-42. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-43. Inspection. Inspection consists of checking for obvious damage, cracked or damaged cover, and loose mounting hardware.

3-44. Repair. Repair consists of replacement of recoil attenuation system.

3-45. Installation.

CAUTION

Slider of system must be installed on feeder side of gun.

a. Apply grease (item 2, App D).
b. Place recoil attenuation system (12 and 15, fig. 3-3) in position on gun and secure with eight bolts.
c. Tighten bolts to 250 to 300 lb-in. torque.

Section IX. MAINTENANCE OF TURRET

3-46. Description. The turret (fig. 1-6) is composed of three main sections: the upper support assembly (upper support), the lower support assembly (lower support), and the saddle assembly (saddle). The upper support is bolted to the aircraft and provides a mount for the azimuth bearing and the azimuth stops and limit switches. The azimuth drive and azimuth resolver assemblies are also mounted on the upper support. The lower support is mounted to the upper support through the azimuth bearing. The output gear of the azimuth drive assembly meshes with the azimuth ring gear bolted to the lower support to provide rotational motion of the lower support. The lower support contains the elevation drive system, stops, elevation limit switches and the emergency stow control unit. The saddle is a frame to support the gun and is mounted through bearings to the lower support. The output gear of the elevation drive meshes with the elevation sector gear on the saddle to provide elevational drive to move the saddle.

3-47. Disassembly.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-39, sheet 6) is disconnected before performing the following procedure.

NOTE

The following disassembly procedures can be accomplished without removing the turret from the aircraft; however, they should be performed only to the extent required to accomplish repair. Remove nylon retaining straps from cable harnesses as required.

a. Remove wear plate (7, fig. 3-40), shim (6), and four screws (8) for replacement only.
b. Remove caution plate (5) only for replacement.
c. Remove cover (1), four screws (3), and four washers (2).

NOTE

Notify next higher maintenance level to remove the turret if it becomes necessary to replace mount (21, fig. 3-40).

d. Remove two screws (24, inset A), two washers (25), and bracket (11).
e. Remove actuator (12), two screws (14), and two washers (13) for replacement only.
f. Remove two screws (23), two washers (22), and bracket (20).
g. Remove actuator (19), two screws (17), and two washers (18) for replacement only.
h. To remove mount (21), remove four screws (16), and four washers (15), then work mount free from mounting pins.

NOTE

Notify next higher maintenance level to remove the azimuth resolver and azimuth drive if it becomes necessary to replace the azimuth switch (proximity switches) assembly (fig. 3-39, sheet 4).

i. Remove four clamps (fig. 3-39, sheet 4) holding azimuth switch assembly (azimuth proximity switches) on upper support.
j. Disconnect connector W1P16 from azimuth switch assembly connector A7J13 on bracket of azimuth drive (fig. 3-39, sheet 1).

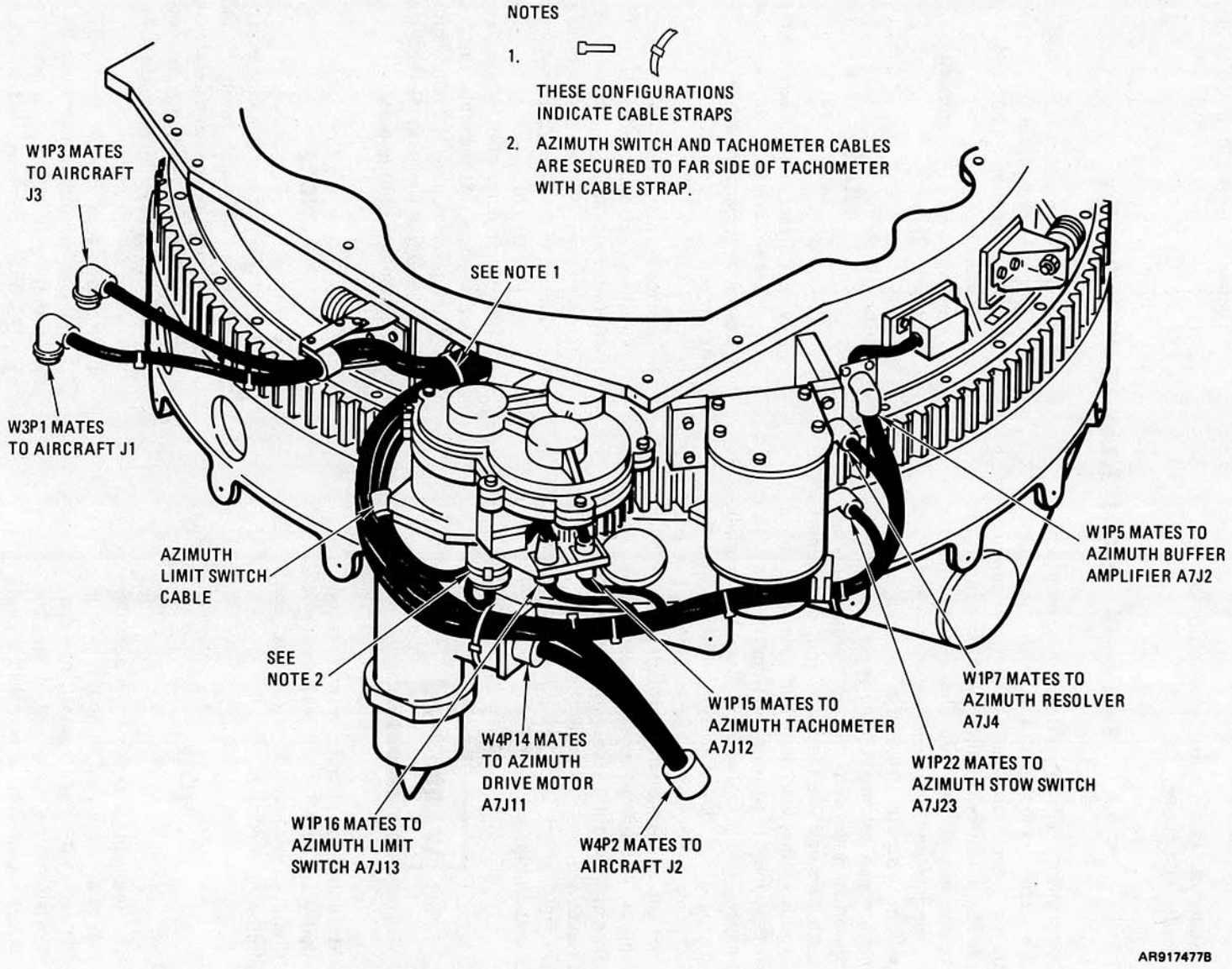


Figure 3-39. Cable Routing Details (Sheet 1 of 6)

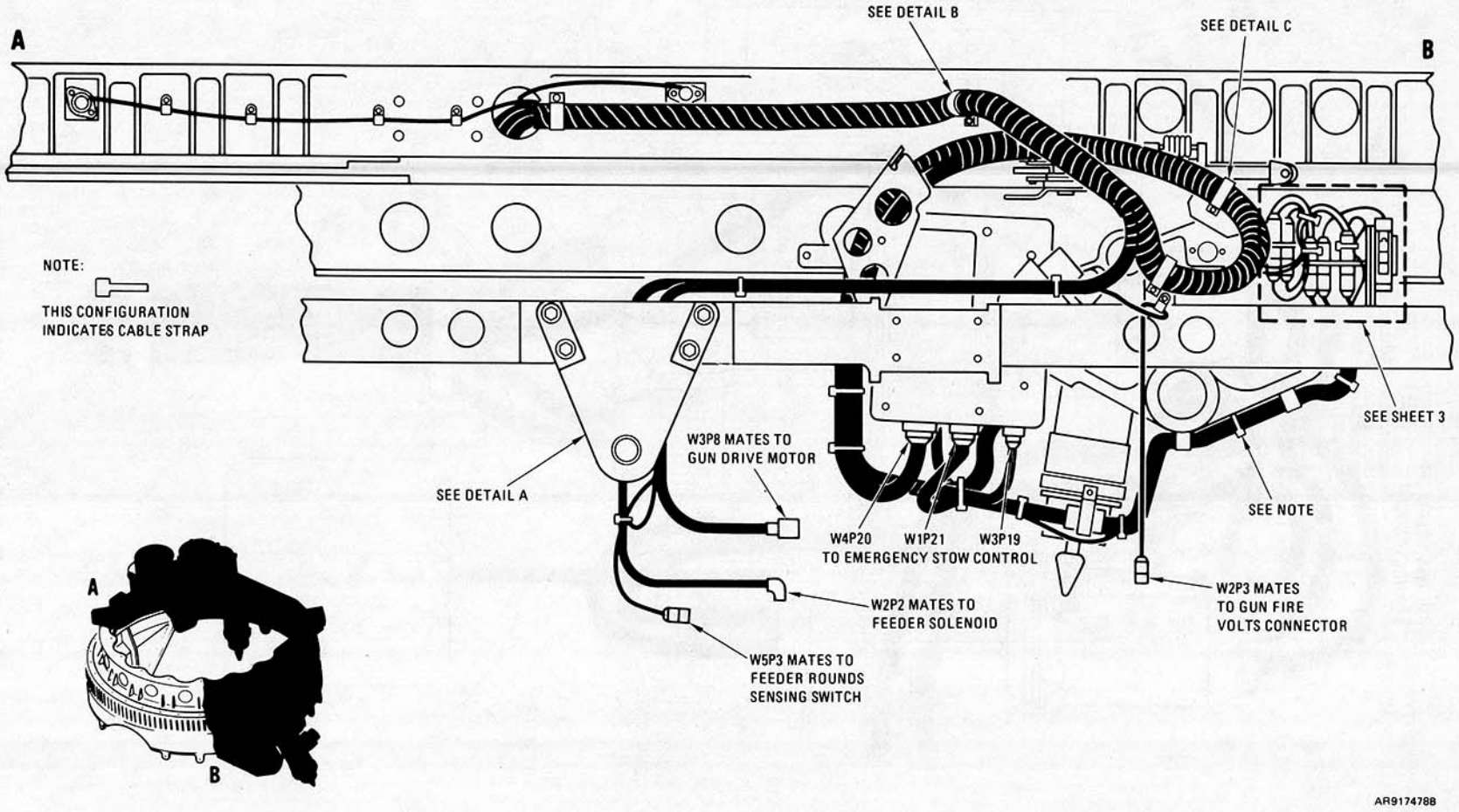


Figure 3-39. Cable Routing Details (Sheet 2 of 6)

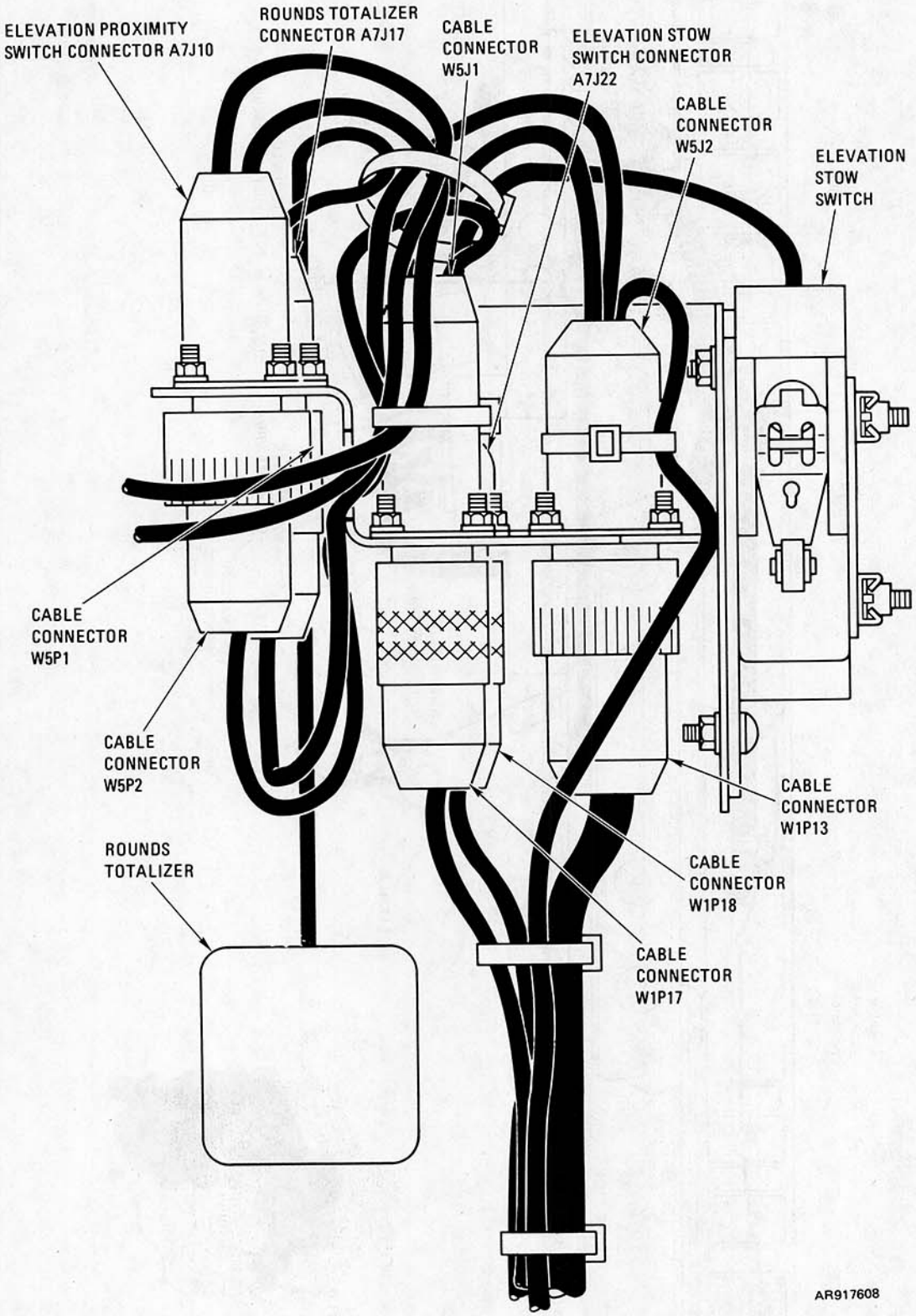


Figure 3-39. Cable Routing Details (Sheet 3 of 6)

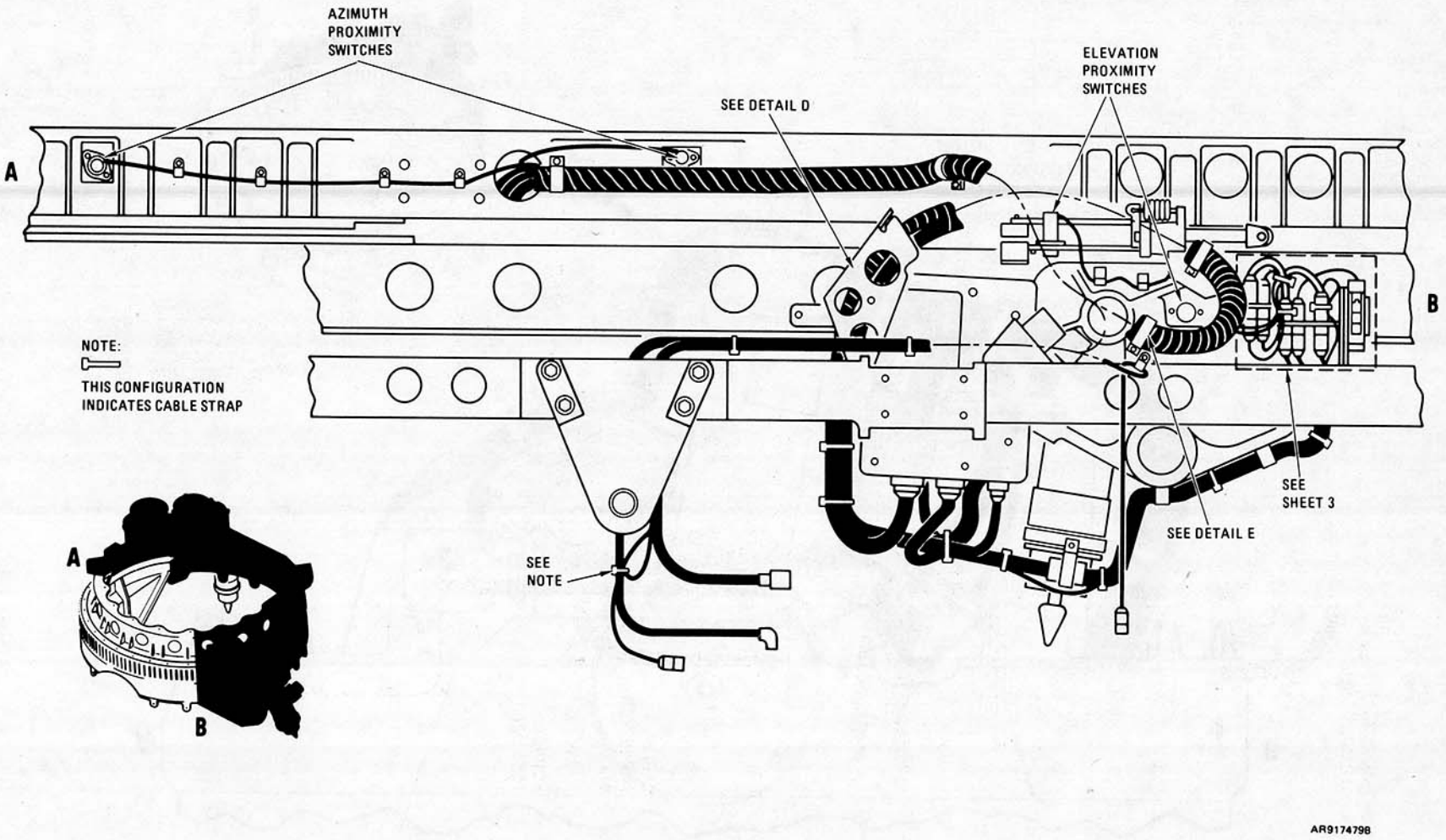


Figure 3-39. Cable Routing Details (Sheet 4 of 6)

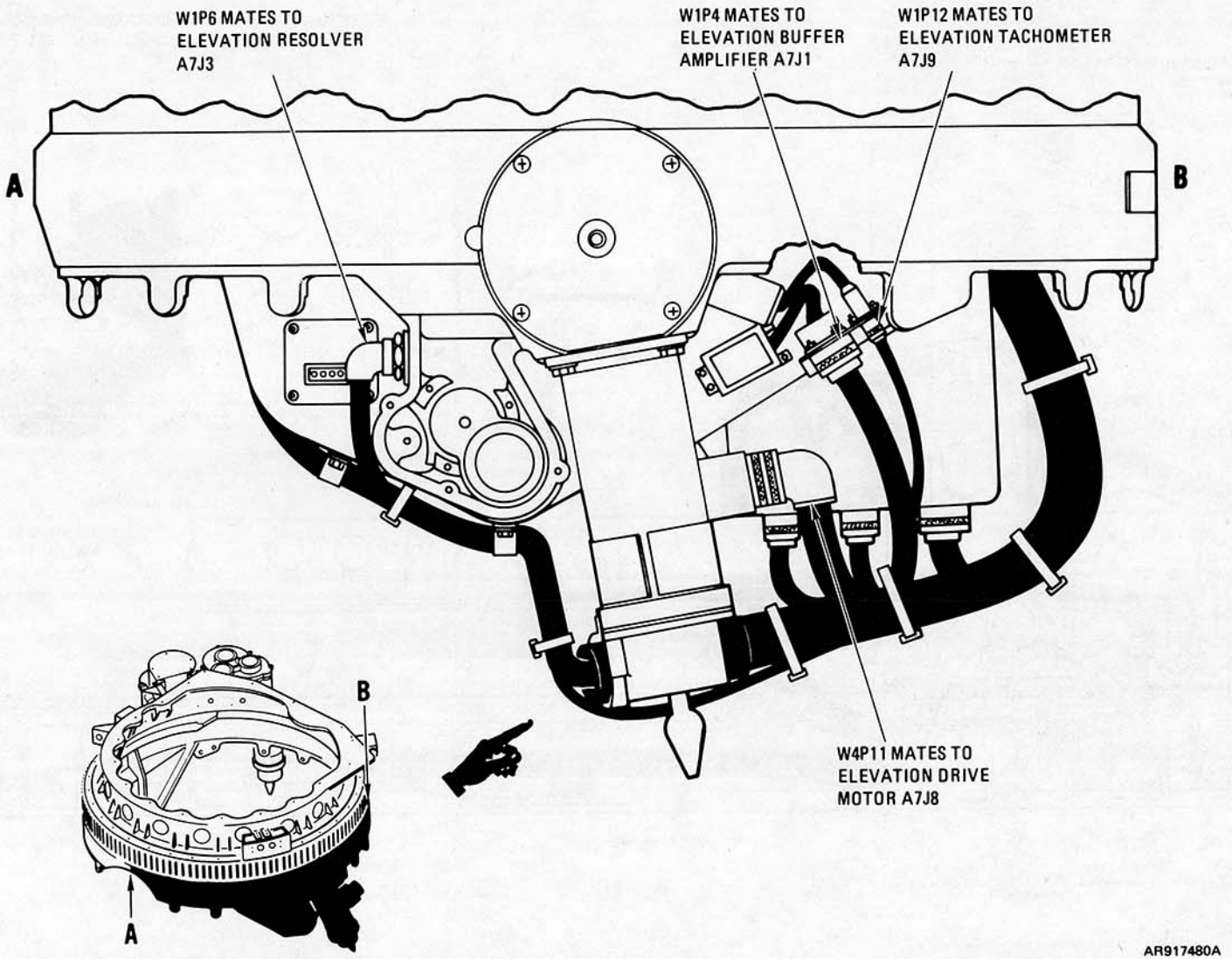


Figure 3-39. Cable Routing Details (Sheet 5 of 6)

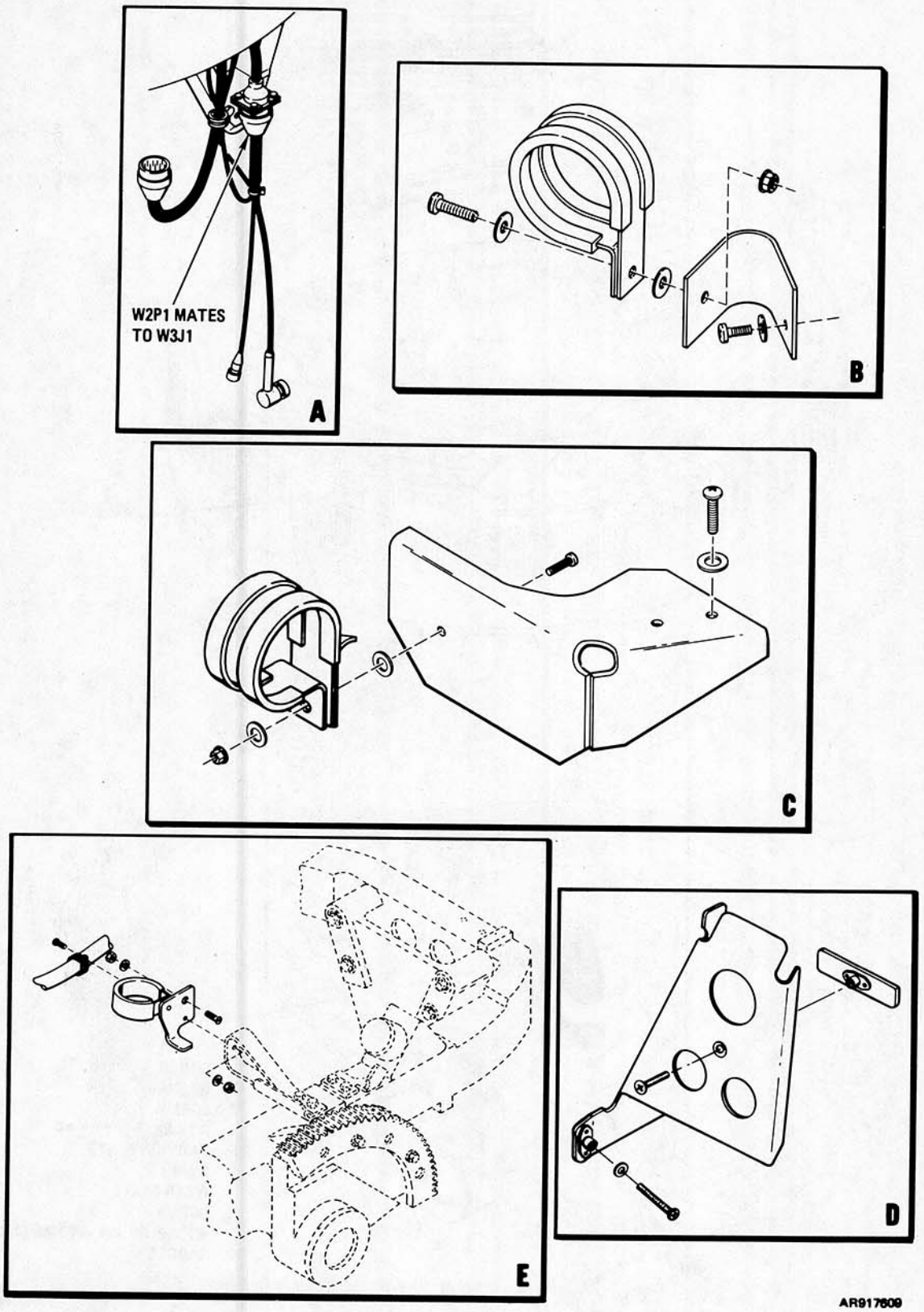


Figure 3-39. Cable Routing Details (Sheet 6 of 6)

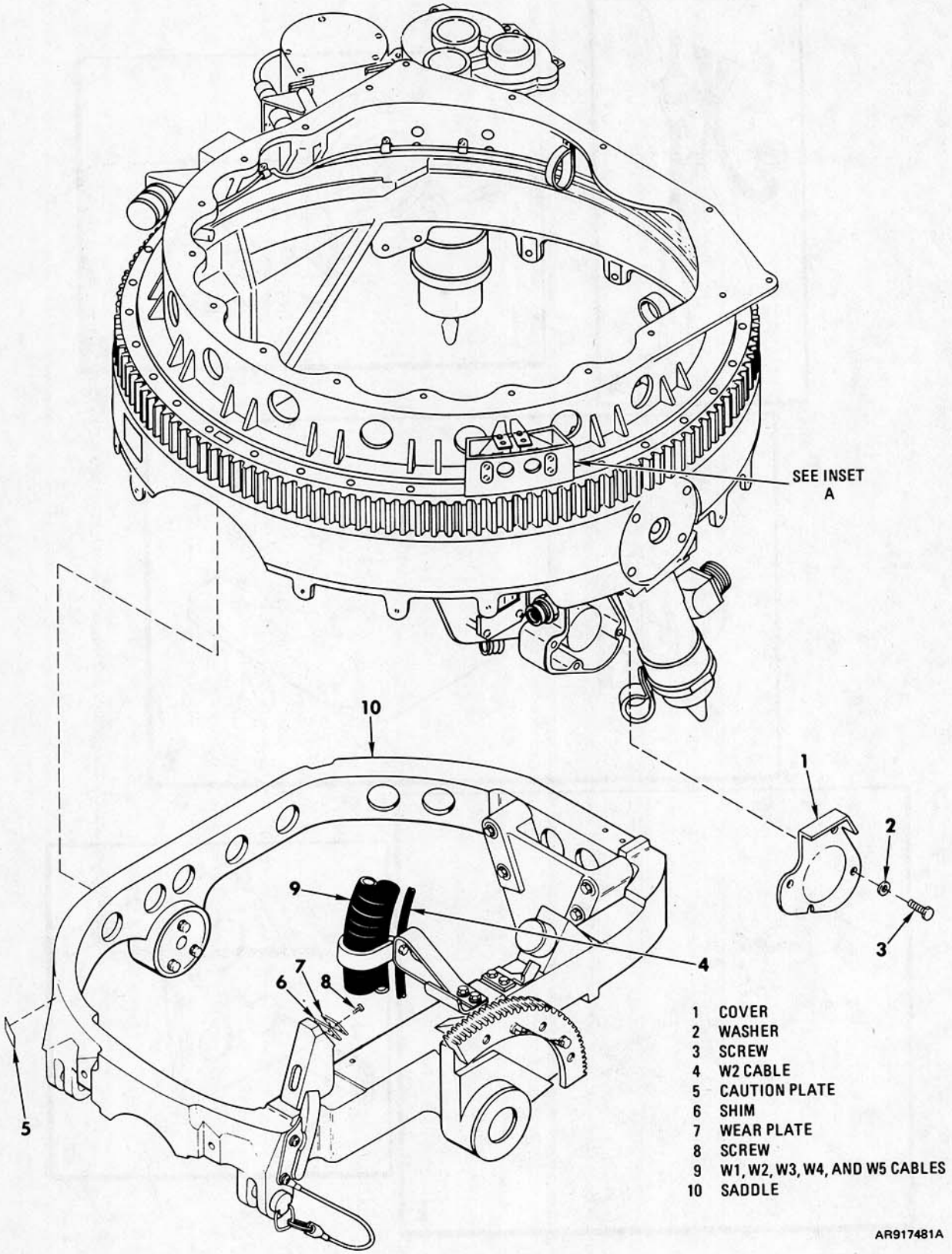
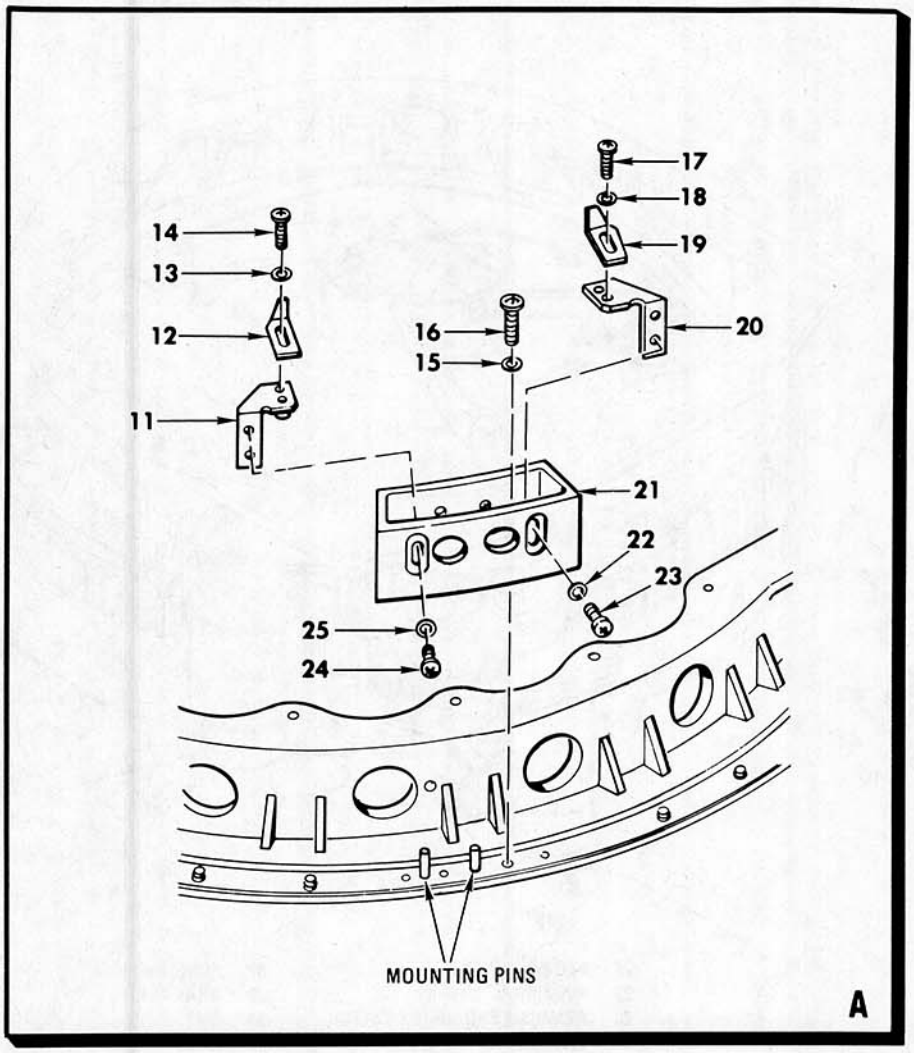


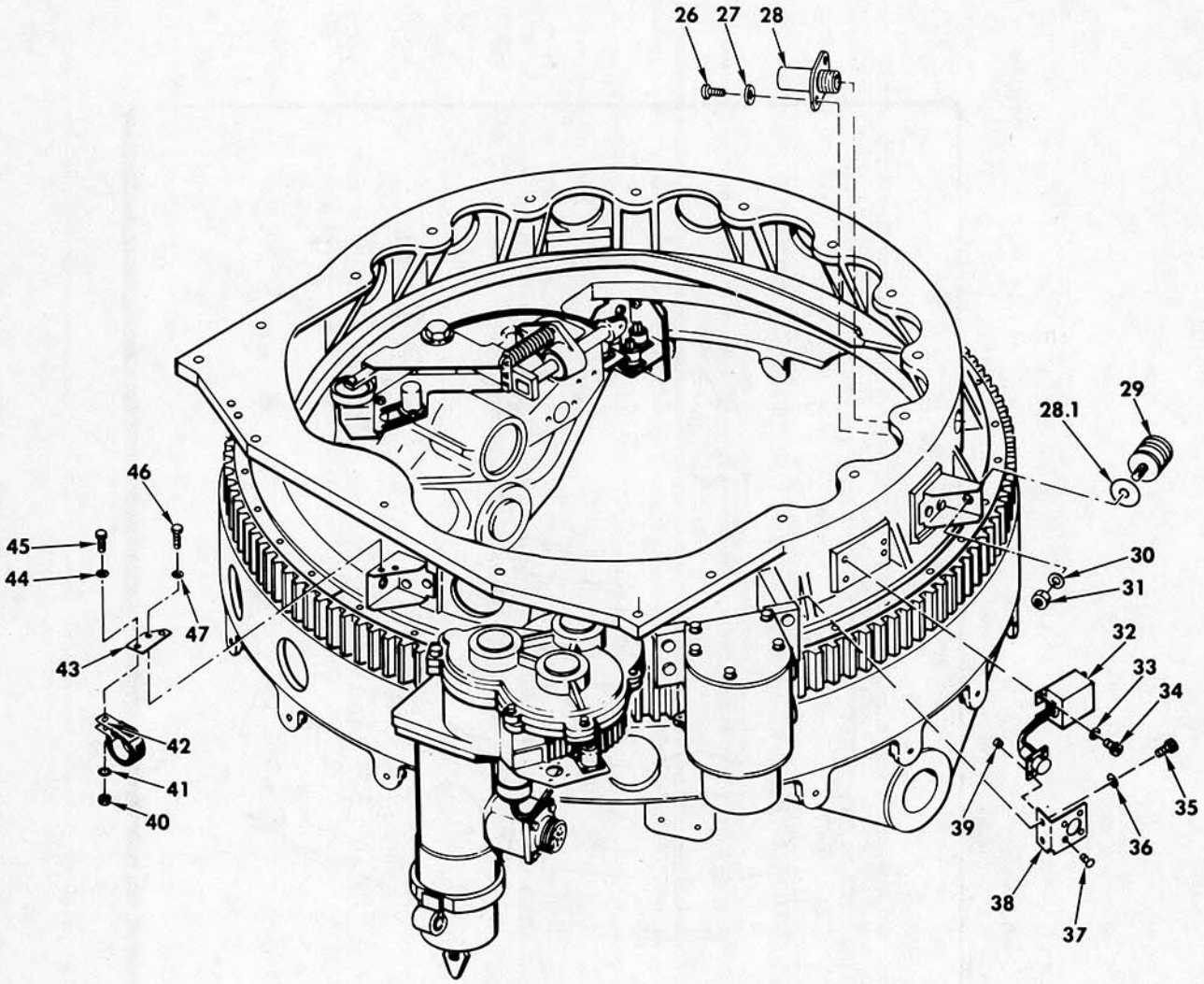
Figure 3-40. Turret — Partially Exploded View (Sheet 1 of 3)



11	BRACKET	19	ACTUATOR
12	ACTUATOR	20	BRACKET
13	WASHER	21	MOUNT
14	SCREW	22	WASHER
15	WASHER	23	SCREW
16	SCREW	24	SCREW
17	SCREW	25	WASHER
18	WASHER		

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Figure 3-40. Turret — Partially Exploded View (Sheet 2 of 3)



26	SCREW	37	SCREW
27	WASHER	38	BRACKET
28	AZIMUTH PROXIMITY SWITCH	39	NUT
28.1	LAMINATED SHIM	40	NUT
29	RUBBER STOP	41	WASHER
30	WASHER	42	CLAMP
31	NUT	43	BRACKET
32	BUFFER AMPLIFIER	44	WASHER
33	WASHER	45	SCREW
34	SCREW	46	SCREW
35	SCREW	47	WASHER
36	WASHER		

Figure 3-40. Turret — Partially Exploded View (Sheet 3 of 3)

NOTE

Notify next higher maintenance level to remove turret if it becomes necessary to replace clamp (42, fig. 3-40) and bracket (43).

k. Remove nut (40), washer (41), clamp (42), screw (45), and washer (44) for replacement only.

l. Remove two screws (46), two washers (47), and bracket (43) for replacement only.

l.1 At azimuth tachometer bracket cut cable strap holding tachometer and azimuth proximity switch cables together (fig. 3-39, sheet 1).

l.2 At opening of aft end of turret cut cable strap holding cables together (fig. 3-39, sheet 1).

l.3 Remove two screws securing azimuth tachometer bracket to azimuth drive.

l.4 Remove four nuts and four screws securing azimuth switch assembly connector A7J8 to azimuth tachometer bracket.

l.5 Work connector end of azimuth proximity switch through opening in aft end of upper support.

m. Remove four screws (26) and four washers (27) securing two azimuth switches (28), and then remove azimuth switch assembly.

n. Remove W1P5 from azimuth buffer amplifier A7J2 (fig. 3-39, sheet 1).

o. Remove two screws (35, fig. 3-40), two washers (36), and bracket (38).

p. Remove buffer amplifier (32) by removing four screws (34) and four washers (33).

q. Remove buffer amplifier connector from bracket by removing four nuts (39) and four screws (37).

CAUTION

If either rubber stop (29) is replaced, it will be necessary for next higher maintenance level to reshim stop and check adjustment of turret azimuth limit switches.

NOTE

Notify next higher maintenance level to remove the azimuth resolver and the azimuth drive if it becomes necessary to replace rubber stop (29) at rear of turret.

r. Remove two nuts (31), two washers (30), two laminated shims (28.1) and two rubber stops (29).

NOTE

Azimuth stop brackets and upper support are matched parts and azimuth stop brackets will not be removed at aviation unit level.

NOTE

When removing cable clamps and cables, mark clamp locations on cables with tape, then reinstall clamps on turret.

NOTE

Notify next higher maintenance level to remove turret from aircraft if it becomes necessary to remove cables W1, W3, and W4.

s. Remove W1, W2, W3, W4, and W5 cables from turret as shown in figure 3-39 for replacement only. Refer to paragraph 3-53, steps e through j for instruction to disconnect cable W5 from connector bracket on lower support.

3-48. Cleaning. Clean parts in accordance with paragraph 3-5b and c.

3-49. Inspection.

a. All parts will be visually inspected and repaired or replaced if found to be defective. Parts will be cleaned prior to inspection in order to effectively accomplish a complete inspection.

b. Table 3-13 lists turret components and possible defects at specified points on the component to assist in accomplishing the visual inspections.

3-50. Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection.

Table 3-13. Turret — Parts Inspection

Component	Possible Defect	Remedy
Cable W1, W2, W3, W4, and W5	Damaged cable covering Bent connector pins	Repair with electrical tape. Straighten.
Connector brackets	Bent or cracked	Straighten or replace.
Azimuth proximity switch assembly	Damaged cable covering	Repair with electrical tape.
Proximity switches	Dented	Test by performing system checkout (table 3-5).
Connector	Bent connector pins	Straighten.
Azimuth proximity switch actuators	Bent, cracked, or broken	Replace.
Azimuth stops	Rubber cracked or deteriorated	Replace.
Azimuth stop mount	Cracked	Replace.
Buffer amplifier assembly (azimuth)	Dented case	Test by performing system checkout (table 3-5).
	Damaged cable covering	Repair.
	Bent connector pins	Straighten.

3-51. Assembly.

CAUTION

If either rubber stop (29) is replaced, it will be necessary for next higher maintenance level to reshim stop and check adjustment of turret azimuth limit switches.

a. Install two rubber stops (29, fig. 3-40), two laminated shims (28.1), two washers (30), and two nuts (31).
b. Mount connector of buffer amplifier (32) on connector bracket (38) with four screws (37) and four nuts (39).
c. Mount buffer amplifier (32) on turret with four screws (34) and four washers (33).
d. Mount connector bracket (38) on turret with two screws (35) and two washers (36).
e. Connect connector W1P5 to azimuth buffer amplifier A7J2 (fig. 3-39, sheet 1).
e.1 From inside of turret work connector end of azimuth proximity switch through opening in aft end of upper support.
e.2 Install azimuth switch assembly connector A7J8 on azimuth tachometer bracket and secure with four nuts and four screws.
e.3 Place azimuth tachometer bracket in position on azimuth drive and secure with two screws.
e.4 At opening of aft end of turret install cable strap as shown in figure 3-39, sheet 1.
e.5 At azimuth tachometer bracket install cable strap holding tachometer and azimuth proximity cables together as shown in figure 3-39, sheet 1.

NOTE

When performing following step, make certain that proximity switch with longer lead is installed on right side of turret.

f. Orient two azimuth proximity switches (28), as shown in figure 3-39, sheet 4. Secure with four screws (26, fig. 3-40) and four washers (27).
g. If removed, install bracket (43) with two screws (46) and two washers (47).
h. Install clamp (42) with screw (45), washer (44), washer (41), and nut (40).
i. Connect W1P16 to azimuth proximity switch assembly connector A7J13 as shown in figure 3-39, sheet 1.
j. Assemble azimuth proximity switch assembly to turret as shown in figure 3-39, sheet 4 with four cable clamps.
k. Position mount (21, fig. 3-40, inset A) on mounting pins and secure with four screws (16) and four washers (15).
l. If removed, mount actuator (19) on bracket (20) and secure with two screws (17) and two washers (18).
m. Position bracket (20) on mount (21) and secure with two screws (23) and two washers (22).
n. If removed, install actuator (12) on bracket (11) and secure with two screws (14) and two washers (13).
o. Position bracket (11) on mount (21) and secure with two screws (24), and two washers (25).
p. Manually position turret so that stop mount (21) is approximately 0.125 inch from turret azimuth stop (rubber bumper). The side to be used (left or right) will be determined by actuator to be adjusted. Both actuators must be adjusted.
q. Adjust switch actuators vertically by loosening screws (23 or 24) and moving actuator brackets (11 and 20) vertically for face coverage of approximately 50 percent of the proximity switch. Tighten screws (23 and 24).
r. Adjust switch actuators (12 or 19) laterally, by loosening vertical screws (14 or 17) to achieve air gap of 0.040 to 0.060 inch.
s. Install cover (1) on turret with four screws (3) and four washers (2).
t. If removed, install caution plate (5) in the following manner:
 (1) Clean plate mounting area with solvent (item 6, App D).
 (2) Apply epoxy coating (item 1, App D) to plate mounting area and allow to dry.
 (3) Attach plate (5) to mounting area. Apply epoxy coating over entire surface of plate and overlap edges approximately 0.125 inch.

NOTE

If shim (6) and/or wear plate (7) are replaced, it will be necessary for next higher maintenance level to check turret mechanical elevation limits and to check adjustment of elevation limit switches.

u. Install shim (6), wear plate (7), and four screws (8).

v. If removed, install cables W1, W2, W3, W4, and W5 as shown in figure 3-39. Refer to paragraph 3-57, steps t. through x.1., for instruction to connect cable W5 to connector bracket on lower support.

w. Manually rotate turret and visually check that all parts have been properly installed and positioned so that adequate clearance exists between all moving parts. Pay particular attention to routing of cables, orientation of cable clamps, and position of switches and actuators.

Section X. MAINTENANCE OF LOWER SUPPORT

3-52. Description.

a. The lower support (fig. 1-6) is mounted to the upper support through the azimuth bearing. The output gear of the azimuth drive meshes with the azimuth ring gear bolted to the lower support to provide rotational motion of the lower support. The lower support contains the elevation drive system, stops, elevation limit switches, and the emergency stow control.

b. The elevation drive system consists of a drive motor and gear box, an associated resolver assembly, and a dc tachometer. The dc tachometer located on the elevation drive gear box provides a negative feedback signal to the servo loop to insure loop stability. The output gear of the elevation drive meshes with the elevation sector gear on the saddle to provide elevational drive to move the saddle.

3-53. Disassembly.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-39, sheet 6) is disconnected before performing the following procedures.

NOTE

The following disassembly procedures, while complete, should be performed only to the extent required to accomplish repair. Disconnect electrical connectors and remove cable straps as required. Detach cable clamps, mark cables where clamps are removed and reinstall clamps and hardware on lower support to avoid possible loss of hardware.

a. Remove W3P19 from J1, W1P21 from J3, and W4P20 from J2 on emergency stow control (fig. 3-39, sheet 2).

b. Remove emergency stow control (3, fig. 3-41) by removing four screws (1) and four washers (2).

c. Deleted.

NOTE

Removing elevation proximity switch S2 (28) will require readjusting switch during assembly.

d. Separate elevation proximity switch S2 (28) and shim (27) from cam link bracket by removing two screws (4) and nut plate (26).

e. At bracket (16, fig. 3-41) cut cable straps holding STOW switch, totalizer and proximity switch cables together (fig. 3-39, sheet 3).

f. Remove W1P17 from connector W5J1 (6) W1P13 from connector W5J2 (7), W1P18 from elevation stow switch connector (20), W5P2 from elevation proximity switch connector (5), and W5P1 from rounds totalizer connector (18) (see fig. 3-39, sheet 3).

g. Separate bracket (16) and attached parts from lower support by removing two screws (14) and two washers (15).

h. Remove elevation proximity switch connector (5) from bracket (16) by removing four nuts (19) and four screws (17).

i. Remove rounds totalizer connector (18) from bracket (16) by removing four nuts (19) and four screws (17)

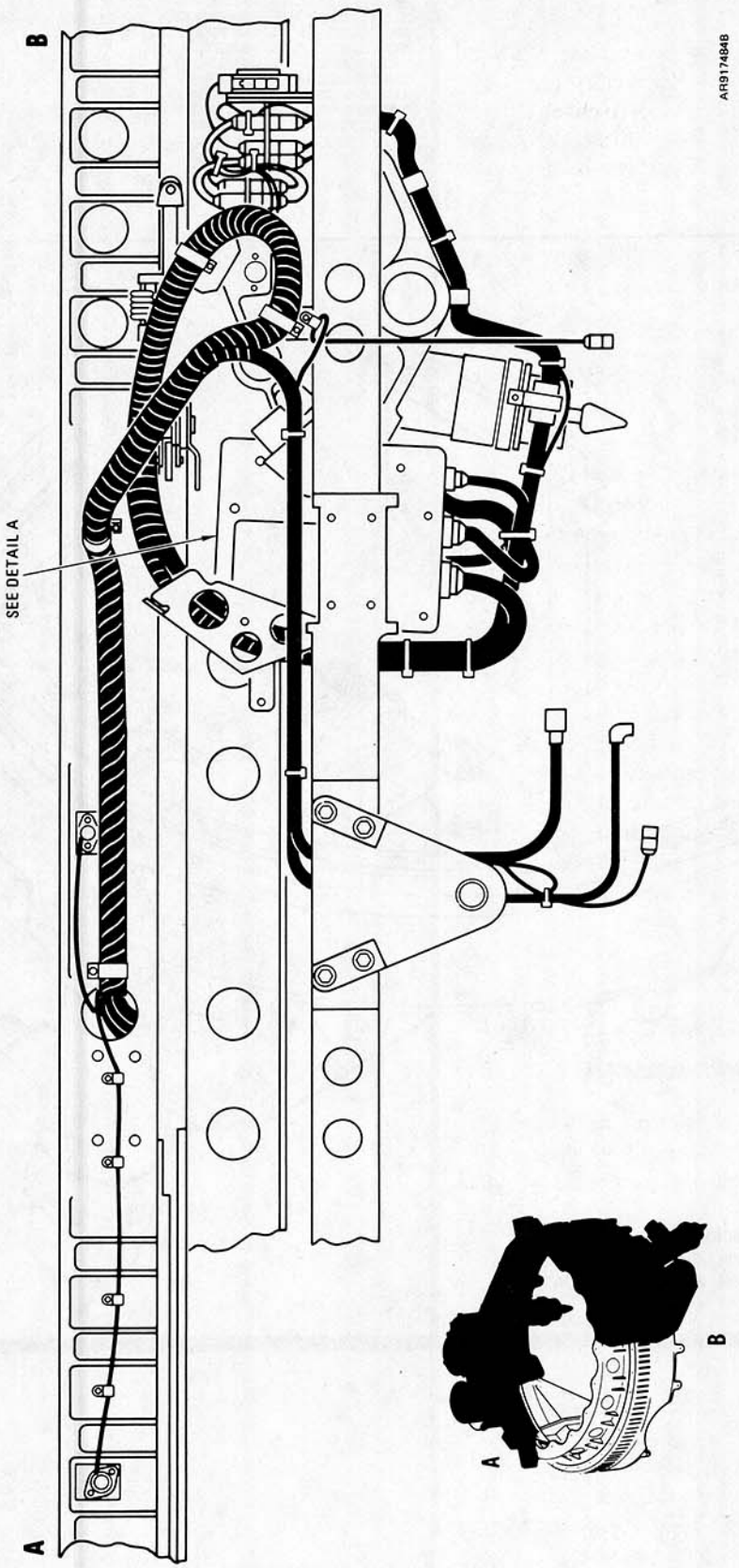


Figure 3-41. Lower Support (Sheet 1 of 5)

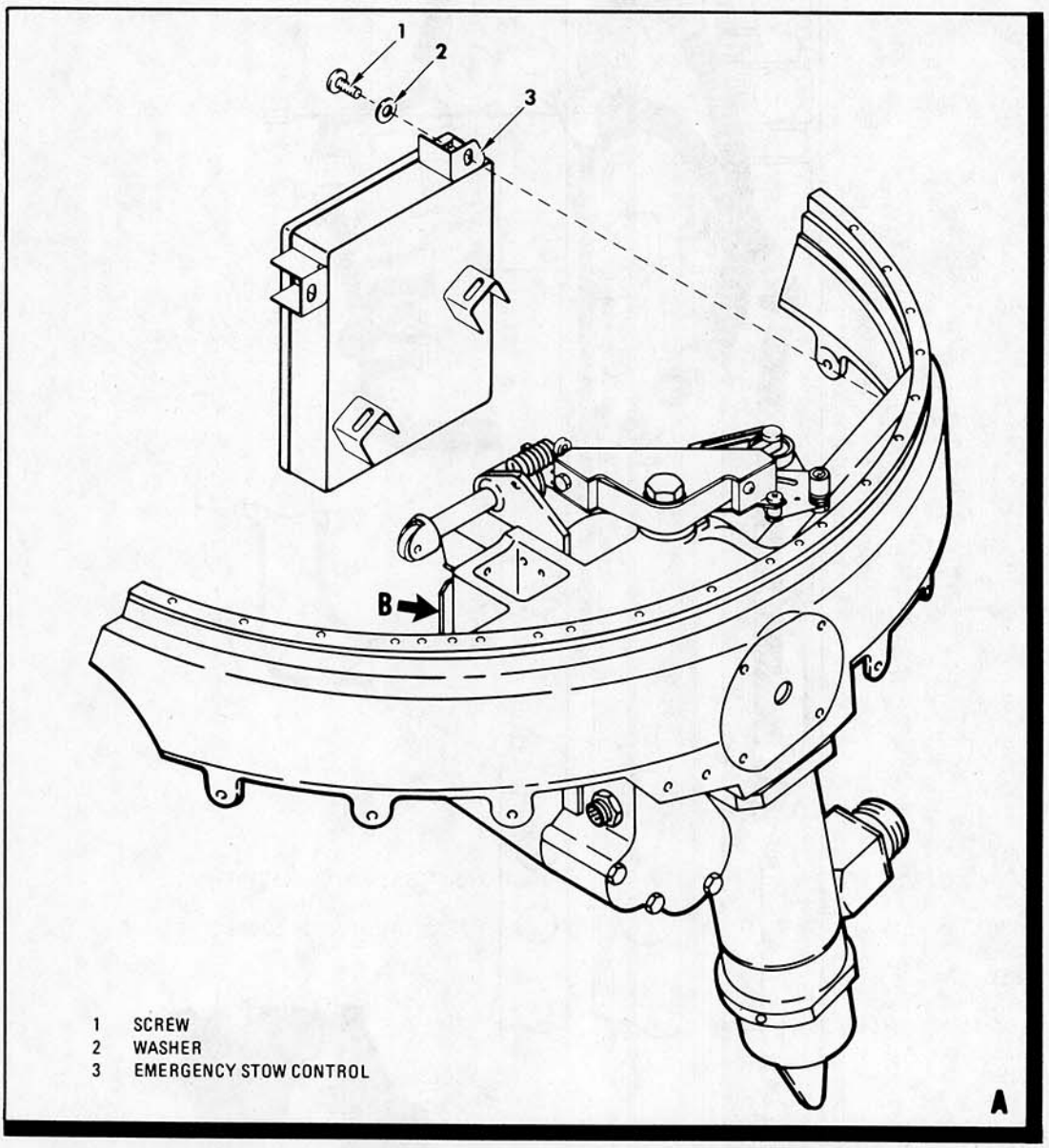
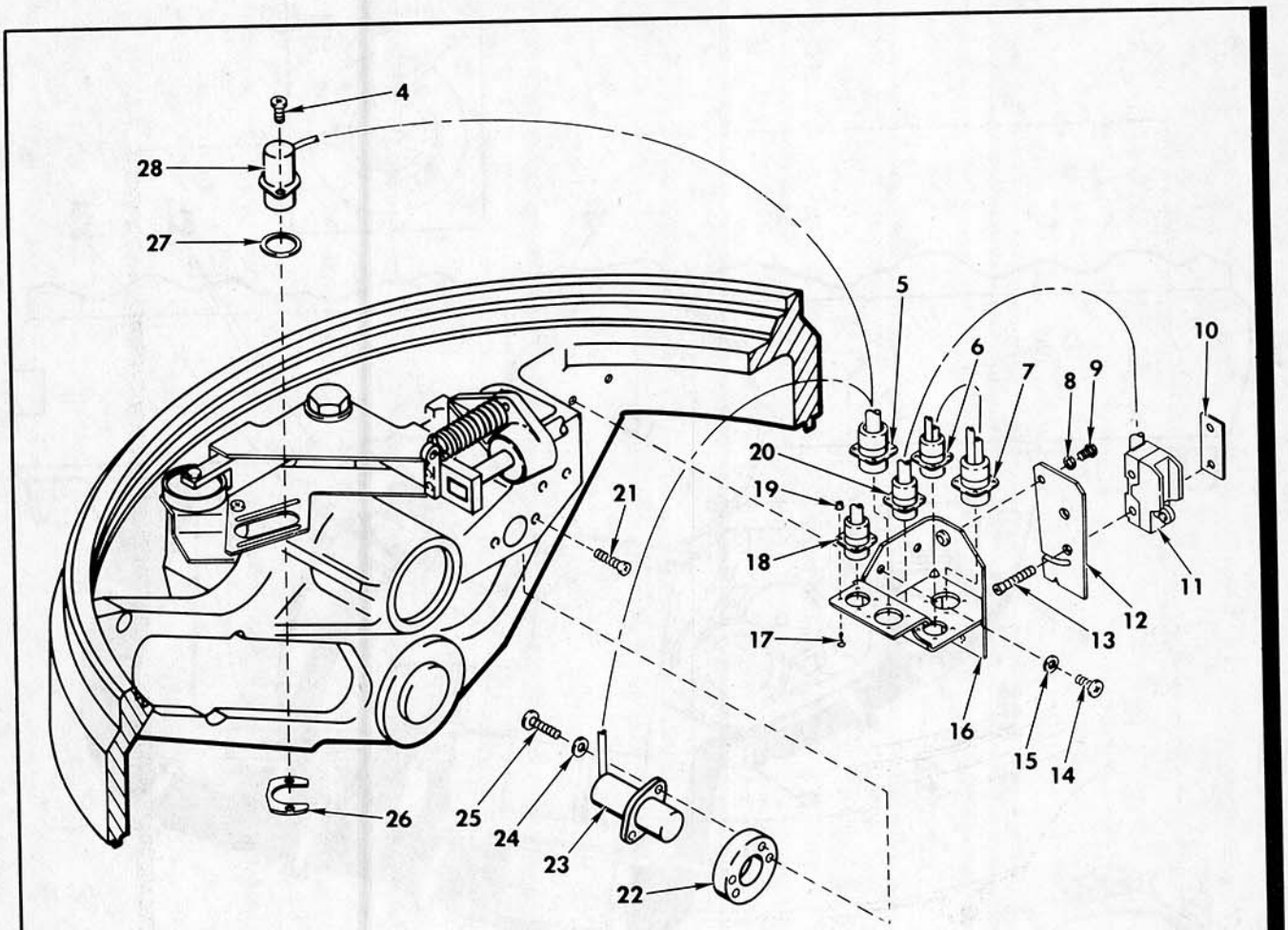


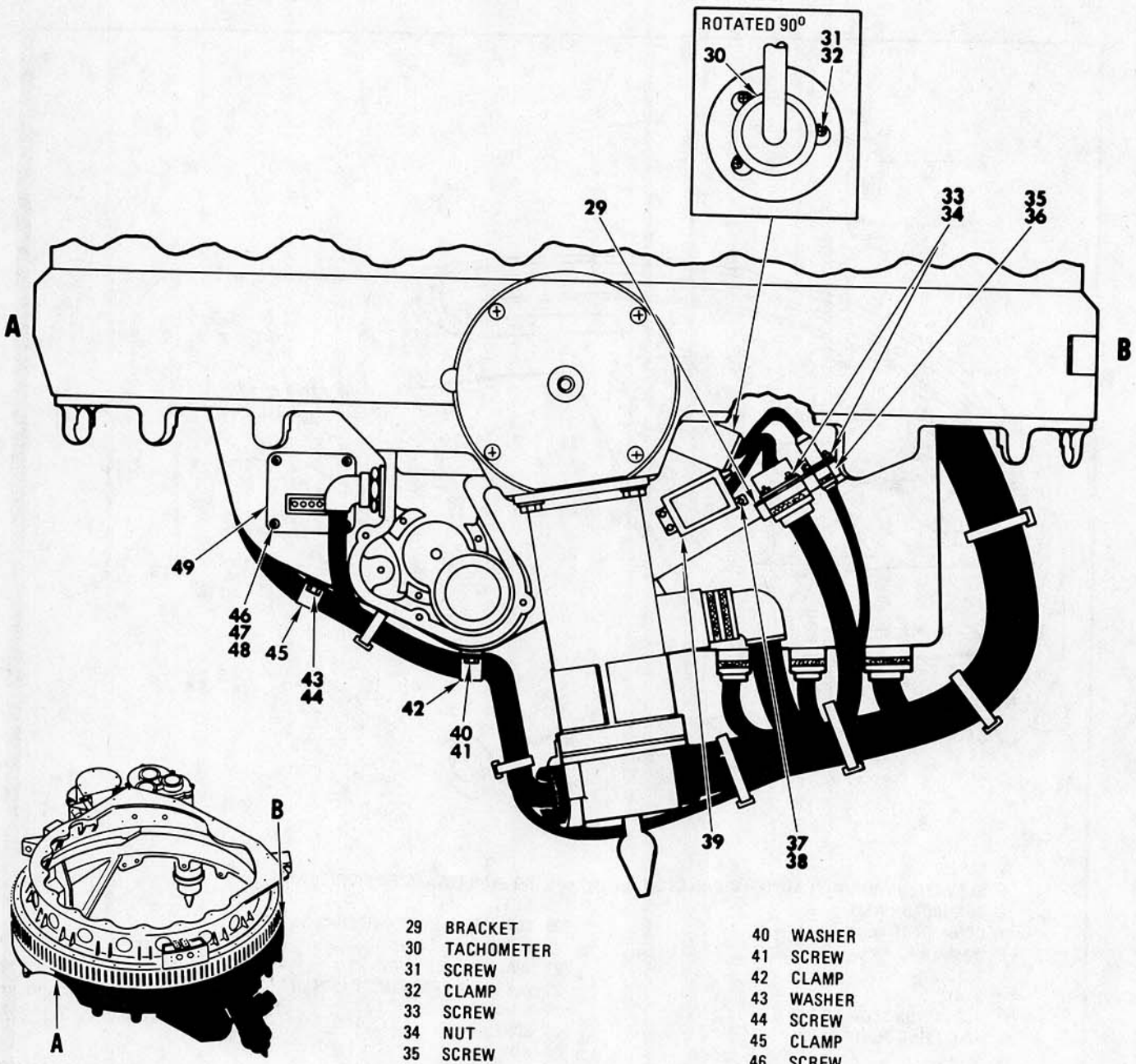
Figure 3-41. Lower Support (Sheet 2 of 5)



4 SCREW
5 ELEVATION PROXIMITY SWITCH CONNECTOR
6 CONNECTOR W5J1
7 CONNECTOR W5J2
8 WASHER
9 SCREW
10 PLATE
11 ELEVATION STOW SWITCH
12 ADJUSTING PLATE
13 SCREW
14 SCREW
15 WASHER
16 BRACKET
17 SCREW
18 ROUNDS TOTALIZER CONNECTOR
19 NUT
20 ELEVATION STOW SWITCH CONNECTOR
21 SCREW
22 SPACER
23 ELEVATION PROXIMITY SWITCH S1
24 WASHER
25 SCREW
26 NUT PLATE
27 SHIM
28 ELEVATION PROXIMITY SWITCH S2

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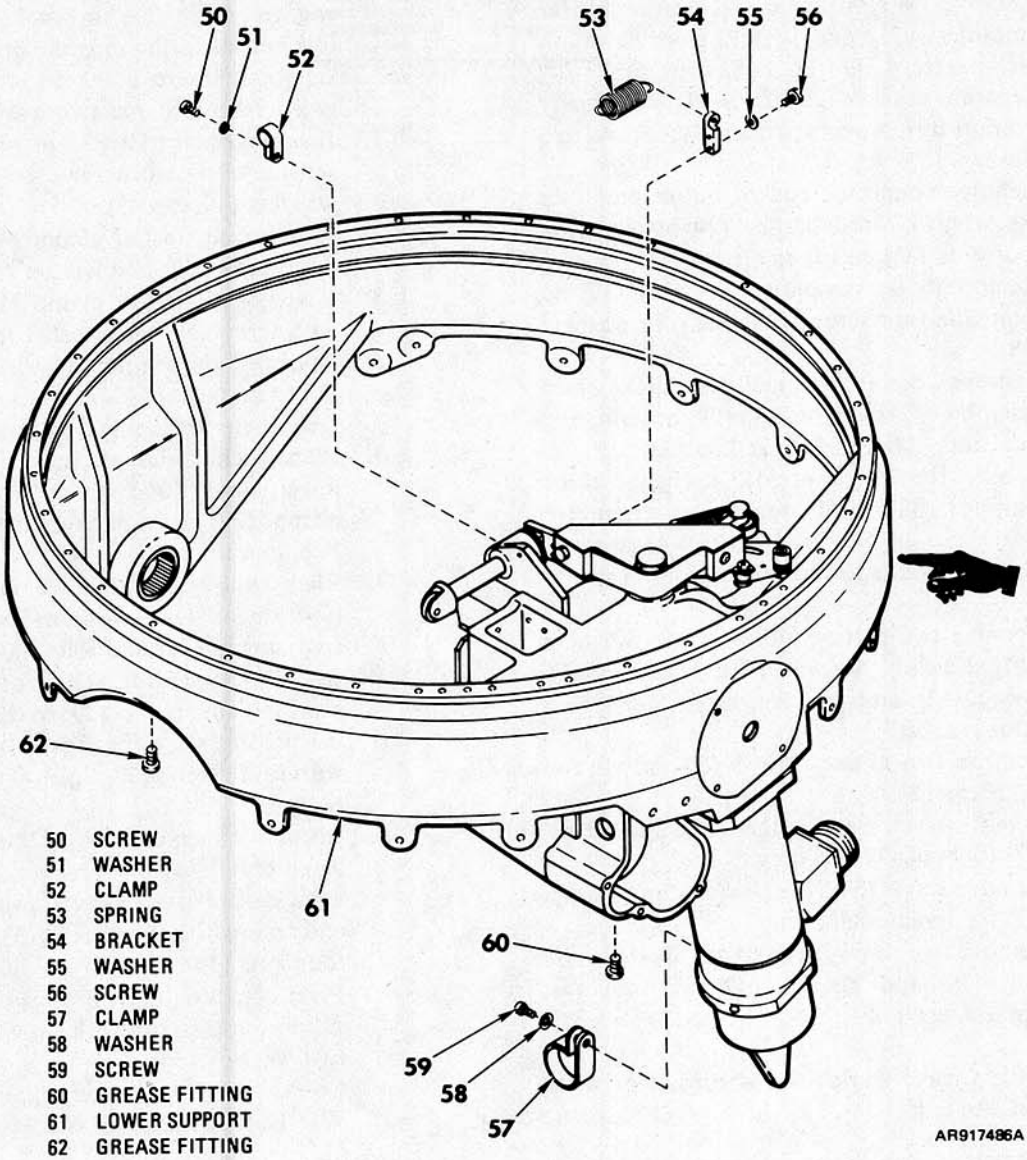
Figure 3-41. Lower Support (Sheet 3 of 5)



29	BRACKET	40	WASHER
30	TACHOMETER	41	SCREW
31	SCREW	42	CLAMP
32	CLAMP	43	WASHER
33	SCREW	44	SCREW
34	NUT	45	CLAMP
35	SCREW	46	SCREW
36	WASHER	47	WASHER
37	SCREW	48	SPACER
38	WASHER	49	ROUNDS TOTALIZER
39	BUFFER AMPLIFIER ASSEMBLY		

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Figure 3-41. Lower Support (Sheet 4 of 5)



50 SCREW
51 WASHER
52 CLAMP
53 SPRING
54 BRACKET
55 WASHER
56 SCREW
57 CLAMP
58 WASHER
59 SCREW
60 GREASE FITTING
61 LOWER SUPPORT
62 GREASE FITTING

Figure 3-41. Lower Support (Sheet 5 of 5)

j. Separate cable W5 from bracket (16) as follows:
 (1) Remove connector W5J1 (6) by removing four nuts (19) and four screws (17).
 (2) Remove connector W5J2 (7) by removing four nuts (19) and four screws (17).

j.1. Remove elevation stow switch connector (20) from bracket (16) by removing four nuts (19) and four screws (17).

k. Remove two screws (9) and two washers (8), and separate bracket (16) from adjusting plate (12).

l. Separate elevation stow switch (11) from adjusting plate (12) by removing two screws (13) and plate (10).

m. Remove two screws (21) and separate spacer (22) and elevation proximity switch S1 (23) from lower support.

n. Remove spacer (22) from elevation proximity switch S1 (23) by removing two screws (25) and two washers (24).

o. Detach elevation switch assembly cable clamps from lower support to remove elevation switch assembly (fig. 3-39, sheet 4). Reinstall clamps.

p. Remove totalizer assembly (49, fig. 3-41) by removing four screws (46), four washers (47), and four spacers (48).

q. Remove W1P4 from elevation buffer amplifier A7J1 and W1P12 from elevation tachometer A7J9 (fig. 3-39, sheet 5).
r. Separate bracket (29, fig. 3-41) from lower support by removing two screws (35) and two washers (36).
s. Remove connector end of buffer amplifier assembly (39) from bracket (29) by removing four nuts (34) and four screws (33).
t. Remove buffer amplifier assembly (39) by removing four screws (37) and four washers (38).
u. Remove connector end of tachometer assembly (30) from bracket (29) by removing four nuts (34) and four screws (33).
v. Loosen three screws (31), disengage three clamps (32) and remove tachometer assembly (30). See inset figure 3-41, sheet 4.
v.1 Position saddle to remove tension on spring (53).
w. Remove two screws (56) and two washers (55) securing bracket (54); then remove spring (53) and bracket. Separate spring from bracket.
x. Remove two grease fittings (60 and 62) for replacement only.
y. Remove screw (59), washer (58), and clamp (57) for replacement only.
z. Remove screw (50), washer (51), and clamp (52) for replacement only.
aa. Remove two screws (41 and 44), washers (40 and 43), and clamps (42 and 45) for replacement only.

3-54. Cleaning. Clean parts in accordance with paragraph 3-5b and c.

3-55. Inspection.

a. Parts will be visually inspected and repaired or replaced if found to be defective. Parts will be cleaned prior to inspection in order to effectively accomplish a complete inspection.

b. Table 3-14 lists lower support components and possible defects at specified points on the component to assist in accomplishing the visual inspections.

3-56. Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection.

3-57. Assembly.

a. If removed, press in grease fittings (60 and 62, fig. 3-41) until seated.
b. Position saddle to approximately 0° elevation. Orient bracket (54) as shown and engage spring (53) to bracket (54). Engage free end of spring in guide bracket on lower support. Secure bracket (54) in place with two screws (56) and two washers (55).
b.1. If removed, install clamps (42 and 45) and secure with two screws (41 and 44) and washers (40 and 43).
b.2. If removed, install clamp (52) and secure with screw (50) and washer (51).
b.3. If removed, install clamp (57) and secure with screw (59) and washer (58).
c. Apply a light coating of grease (item 2, App D), to surfaces of lower support that contact tachometer assembly (30) and teeth of gear.
d. Place tachometer assembly in position on lower support and secure by engaging three clamps (32) and tightening three screws (31). See figure 3-41, sheet 4.
e. Place buffer amplifier assembly (39) in position on lower support and secure with four screws (37) and four washers (38).
f. Install connector end of tachometer assembly on bracket (29) so that keyways are oriented as shown in figure 3-42 and secure with four screws (33, fig. 3-41) and four nuts (34).
g. Install connector end of buffer amplifier assembly (39) on bracket (29) so that keyways are oriented as shown in figure 3-42 and secure with four screws (33, fig. 3-41) and four nuts (34).
h. Place bracket (29) in position on lower support and secure with two screws (35) and two washers (36).
i. Connect W1P4 to buffer amplifier A7J1 and W1P12 to tachometer A7J9 (fig. 3-39, sheet 5).
j. Place one spacer (48, fig. 3-41) and totalizer assembly (49) in position on lower support and install one screw (46) and washer (47). Do not tighten screw.
k. Install remaining three spacers (48), three screws (46), and three washers (47); then tighten four screws (46).

CAUTION

To avoid possible damage to elevation proximity switch, do not rotate lower support when performing steps l through 0 below.

l. Position elevation switch assembly on lower support using cable clamps and cable straps

Table 3-14. Lower Support — Parts Inspection

Component	Possible Defect	Remedy
Emergency stow control	Dented case	Test by performing system checkout (table 3-5).
	Bent connector pins	Straighten.
Emergency stow switch	Defective switch	Replace.
	Damaged cable covering	Repair.
	Bent connector pins	Straighten.
Adjusting plate (emergency stow switch)	Bent or cracked	Straighten or replace.
Totalizer assembly	Defective	Replace totalizer assembly.
	Damaged cable covering	Repair.
	Bent connector pins	Straighten.
Tachometer assembly (elevation)	Rough or noisy rotor bearings	Replace tachometer assembly.
	Bent shaft	Replace tachometer assembly.
	Damaged cable covering	Repair.
	Bent connector pins	Straighten.
Buffer amplifier assembly (elevation)	Dented case	Test by performing system checkout (table 3-5).
	Damaged cable covering	Repair.
	Bent connector pins	Straighten.
Elevation proximity switch assembly	Damaged cable covering	Repair.
Proximity switches	Dented	Test by performing system checkout (table 3-5).
Connector	Bent connector pins	Straighten.
Connector brackets	Bent or cracked	Straighten or replace.
Cover (elevation drive)	Deformed or defective	Replace.
Limit switch bracket	Bent or cracked	Replace.
Link return spring	Deformed	Replace.
Spring bracket	Cracked	Replace.
Lower support	Cracked	Replace.

in accordance with figure 3-39, sheet 4.

m. Install spacer (22, fig. 3-41) on elevation proximity switch S1 (23) with smaller diameter screw inserts toward switch (23) and secure with two screws (25) and washers (24).

n. Place elevation proximity switch S1 (23) and spacer (22) in position on lower support and secure with two screws (21).

n.1. Attach elevation proximity switch S2 (28) to cam link bracket using shim (27), two screws (4), and nut plate (26). Shim to obtain gap specified in figure 3-41.1.

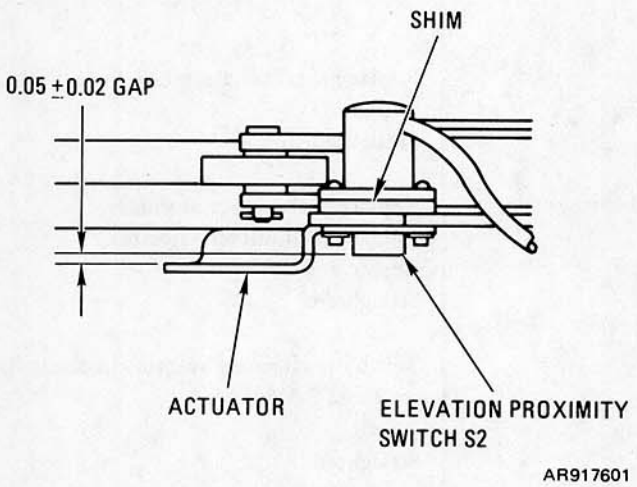


Figure 3-41.1 Elevation Proximity Switch S2 — Adjustment Details

o. Place saddle in a down elevation position so that elevation stop (rubber bumper) is approximately 1/8 inch from lower mechanical stop bracket on lower support.

p. Adjust down elevation proximity switch actuator on saddle by loosening two screws and moving actuator to cover approximately 50 percent of elevation proximity switch S1 (23, fig. 3-41) with an airgap of 0.040 to 0.060 inch. Final adjustment will be made during system checkout.

q. Tighten two screws on actuator.

r. Install adjusting plate (12) on elevation stow switch (11) and secure with plate (10) and two screws (13).

s. Place bracket (16) in position on adjusting plate and install, but do not fully tighten two screws (9) and two washers (8).

s.1. Install elevation stow switch connector (20) on bracket (16) so that keyways are oriented as shown in figure 3-42 and secure with four screws (17, fig. 3-41) and four nuts (19).

t. Attach cable W5 to bracket (16) as follows:
 (1) Install connector W5J2 (7) so that keyways are oriented as shown in figure 3-42 and secure with four screws (17, fig. 3-41) and four nuts (19).
 (2) Install connector W5J1 (6) so that keyways are oriented as shown in figure 3-42 and secure with four screws (17, fig. 3-41) and four nuts (19).

u. Install rounds totalizer connector (18) on bracket (16) so that keyways are oriented as shown in figure 3-42 and secure with four screws (17, fig. 3-41) and four nuts (19).

v. Install elevation proximity switch connector (5) on bracket (16) so that keyways are oriented as shown in figure 3-42 and secure with four screws (17, fig. 3-41) and four nuts (19).

w. Place bracket (16) in position on lower support and secure with two screws (14) and two washers (15).

x. Connect W5P1 to rounds totalizer connector (18), W5P2 to elevation proximity switch connector (5), W1P18 to elevation stow switch connector (20), W1P13 to connector W5J2 (7), and W1P17 to connector W5J1 (6). (See fig. 3-39, sheet 3.)

x.1. Using cable straps, tie totalizer, proximity switch, stow switch, and W5 cables together as shown in figure 3-39, sheet 3.

y. Position turret at zero degree azimuth and +10 degrees elevation.

z. If connected, disconnect W1P21 from emergency stow control A7A1J3.

aa. Connect multimeter to read continuity between pins N and M of W1P21.

ab. Adjust stow switch adjusting plate (12, fig. 3-41) and cam (fig. 3-43) at mid-point of their adjusting range at point where open circuit appears. Final adjustment will be made during system checkout.

ac. Tighten screws securing stow switch adjusting plate and cam.

ad. Deleted.

ae. Deleted.

af. Deleted.

ag. Deleted.

ah. Position turret to obtain a space of one-eighth of an inch between cam roller and cam (fig. 3-44).

ai. Loosen screws (4, fig. 3-41) and adjust elevation proximity switch S2 (28) to obtain approximately 50 percent face coverage. Tighten screws (4).

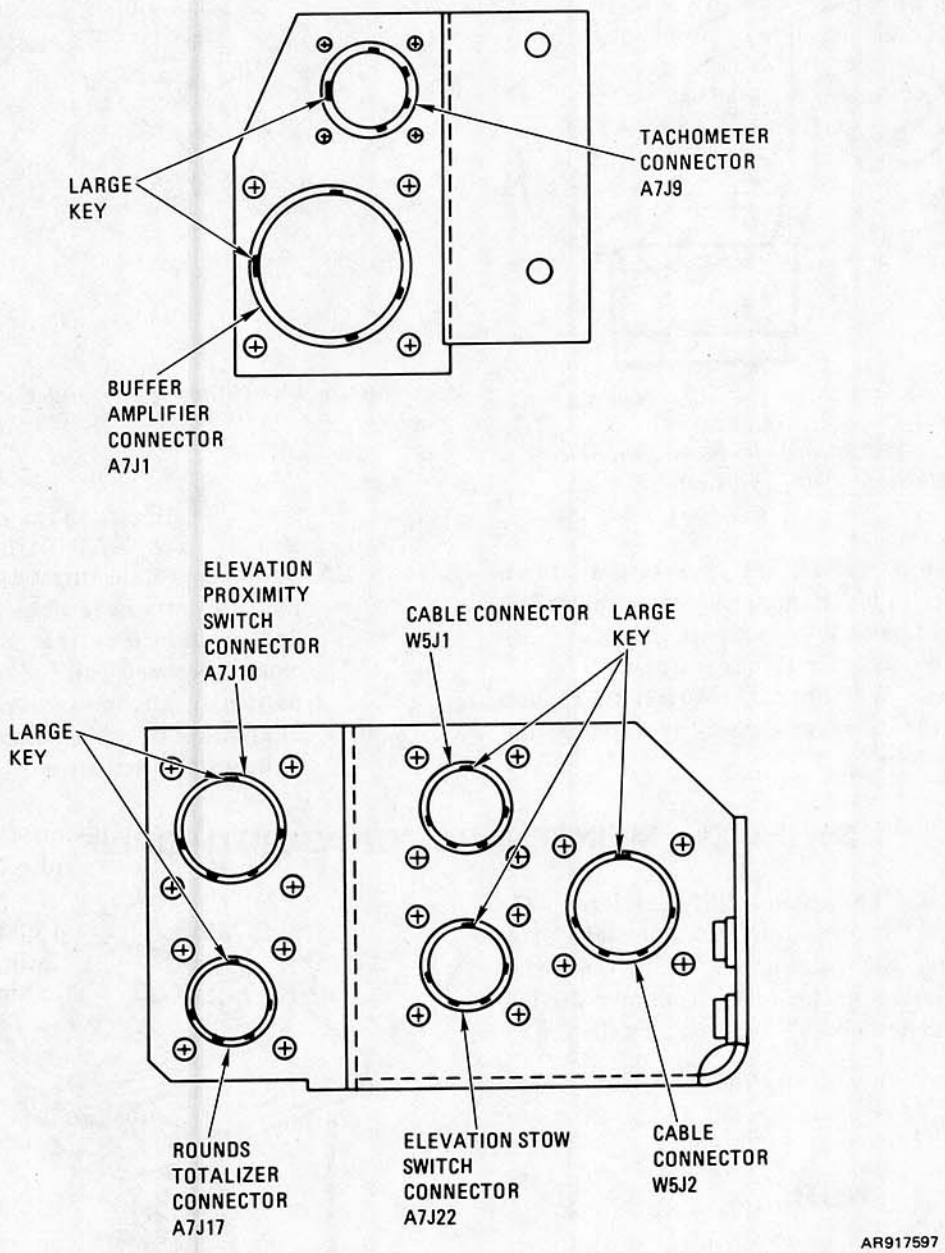


Figure 3-42. Location and Orientation of Connectors

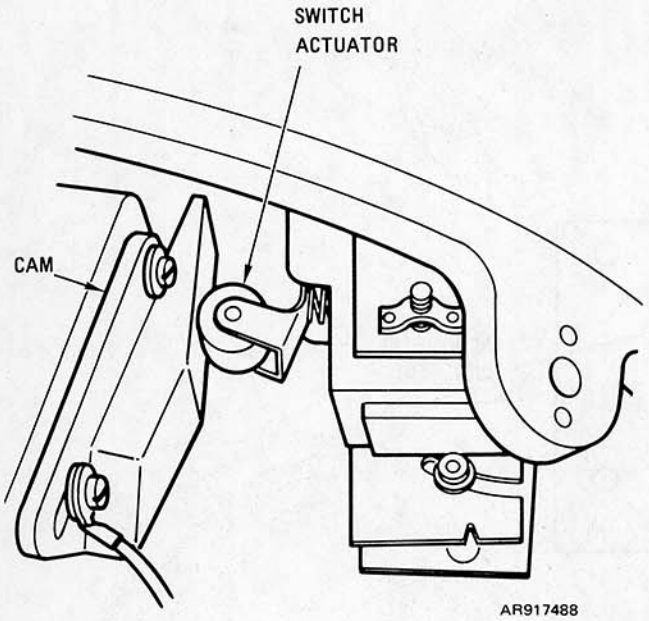


Figure 3-43. Adjustment of Stow Switch Adjusting Plate and Cam

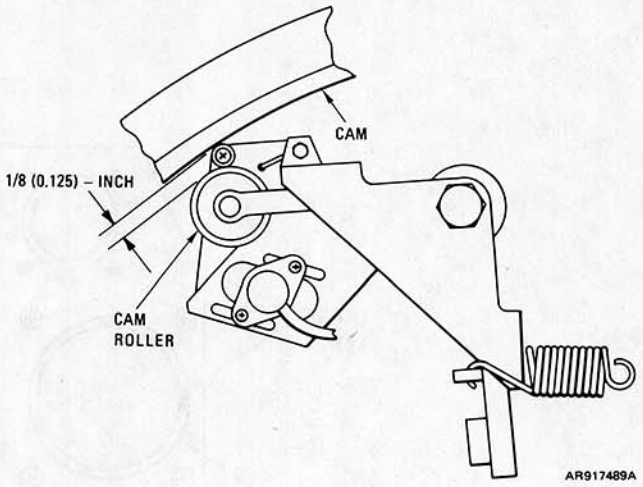


Figure 3-44. Cam Roller and Cam Orientation

aj. Position saddle at maximum down elevation. Place emergency stow control (3) in position on lower support and secure with four screws (1) and four washers (2).

ak. Connect W4P20 to J2, W1P21 to J3, and W3P19 to J1 on emergency stow control (fig. 3-39, sheet 2).

al. Manually rotate turret and visually check that all parts have been properly installed and positioned so that adequate clearance exists between all moving parts. Pay particular attention to routing of cables, orientation of cable clamps, and position of switches and actuators.

Section XI. MAINTENANCE OF AZIMUTH DRIVE

3-58. Description. The azimuth drive, figure 3-45, turns the gun to 110° azimuth left and right. The tachometer, located on the gearbox, keeps the turret from driving too fast, stops the turret from over-driving the point of conversion and also prevents oscillation of the turret.

3-59. Disassembly.

NOTE

Notify next higher maintenance level to remove azimuth drive if it becomes necessary to replace tachometer (1, fig. 3-46).

a. Remove four screws (2, fig. 3-46), four nuts (4), and tachometer connector (3).

b. Remove three screws (10), three clamps (11), and tachometer (1).

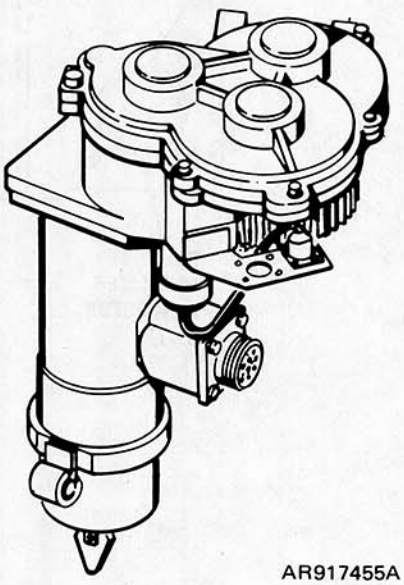


Figure 3-45. Azimuth Drive

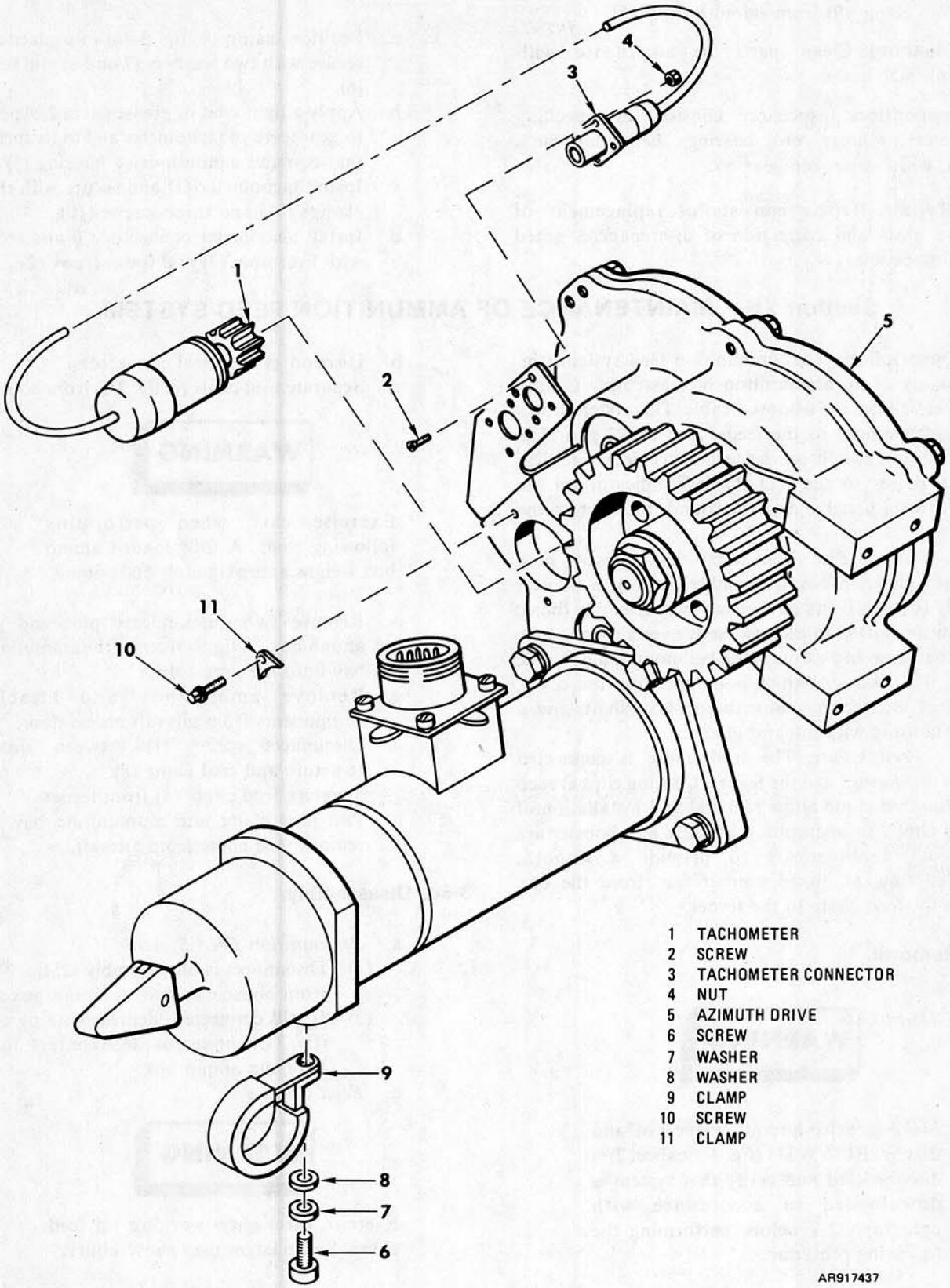


Figure 3-46. Azimuth Drive Assembly — Exploded View

c. Remove screw (6), washers (7 and 8) and clamp (9) from azimuth drive (5).

3-60. Cleaning. Clean parts in accordance with paragraph 3-5b and c.

3-61. Inspection. Inspection consists of checking tachometer for noisy rotor bearings, bent shaft, or a chipped, worn or broken gear.

3-62. Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection.

3-63. Assembly.

a. Position clamp (9, fig. 3-46) into place and secure with two washers (7 and 8) and screw (6).
b. Apply a light coat of grease (item 2, App D) to gear teeth of tachometer and to its surface that contacts azimuth drive housing (5).
c. Install tachometer (1) and secure with three clamps (11) and three screws (10).
d. Install tachometer connector (3) and secure with four nuts (4) and four screws (2).

Section XII. MAINTENANCE OF AMMUNITION FEED SYSTEM

3-64. Description. The ammunition feed system (fig. 1-7) consists of an ammunition box assembly (ammo box), a feed chute, and a booster cable. This system stores and supplies ammo to the feeder and M197 gun. The rounds sensing switch on the feeder provides electrical counting pulses to the RD RMNG indicator on the gunner control panel and to the rounds totalizer on the turret.

a. *Ammo Box.* The ammo box consists of a bellmouth guide, a cover assembly (cover), a booster assembly (booster), and a three-bay box assembly (box). Ammunition stored in the box feeds over a roller at the end of the cover and through the bellmouth guide to the booster. The booster, which is mounted on the cover, consists of an electric motor, a sprocket shaft, and a booster housing with integral guides.

b. *Feed Chute.* The feed chute is connected between the booster and the feeder. Chuting clips at each end of the feed chute allow removal and installation of the feed chute. In operation the feeder and booster are energized simultaneously to provide a smooth, controlled flow of linked ammunition from the box through the feed chute to the feeder.

3-65. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-39, sheet 2) is disconnected and verify that system is downloaded in accordance with paragraph 2-7 before performing the following procedures.

a. Open left and right ammunition bay doors.
b. Disconnect electrical connectors.
c. Separate feed chute (8, fig. 3-3) from booster.

WARNING

Exercise care when performing following steps. A fully loaded ammo box weighs approximately 500 pounds.

d. Remove two quick-release pins and pull ammo box (7, fig. 3-3) out of the ammunition bay onto the access door.
e. Remove ammo box and attached components from aircraft access door.
f. Disconnect spring (1) between aircraft structure and feed chute (8).
g. Separate feed chute (8) from feeder.
h. Pull feed chute into ammunition bay and remove feed chute from aircraft.

3-66. Disassembly.

a. *Ammunition Feed System*
 (1) Disconnect cable assembly (2, fig. 3-47) from booster motor on ammo box (3).
 (2) If still connected, depress chuting clips (fig. 3-5) and remove feed chute (1, fig. 3-47) from ammo box.
b. *Feed Chute.*

WARNING

Exercise care when working on feed chute. Sharp edges may cause injury.

 (1) Place feed chute on workbench as shown in figure 3-48.

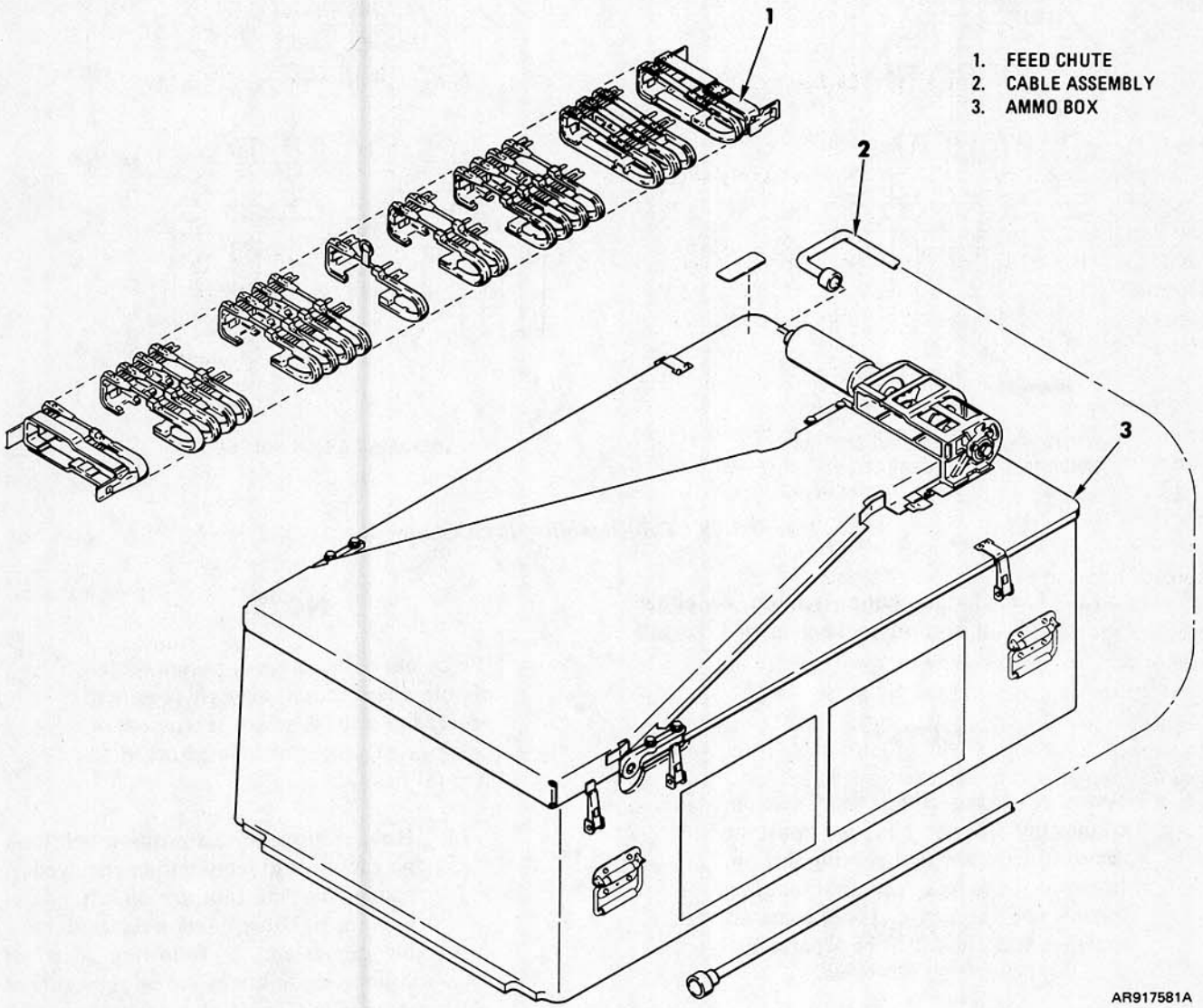


Figure 3-47. Ammunition Feed System — Exploded View

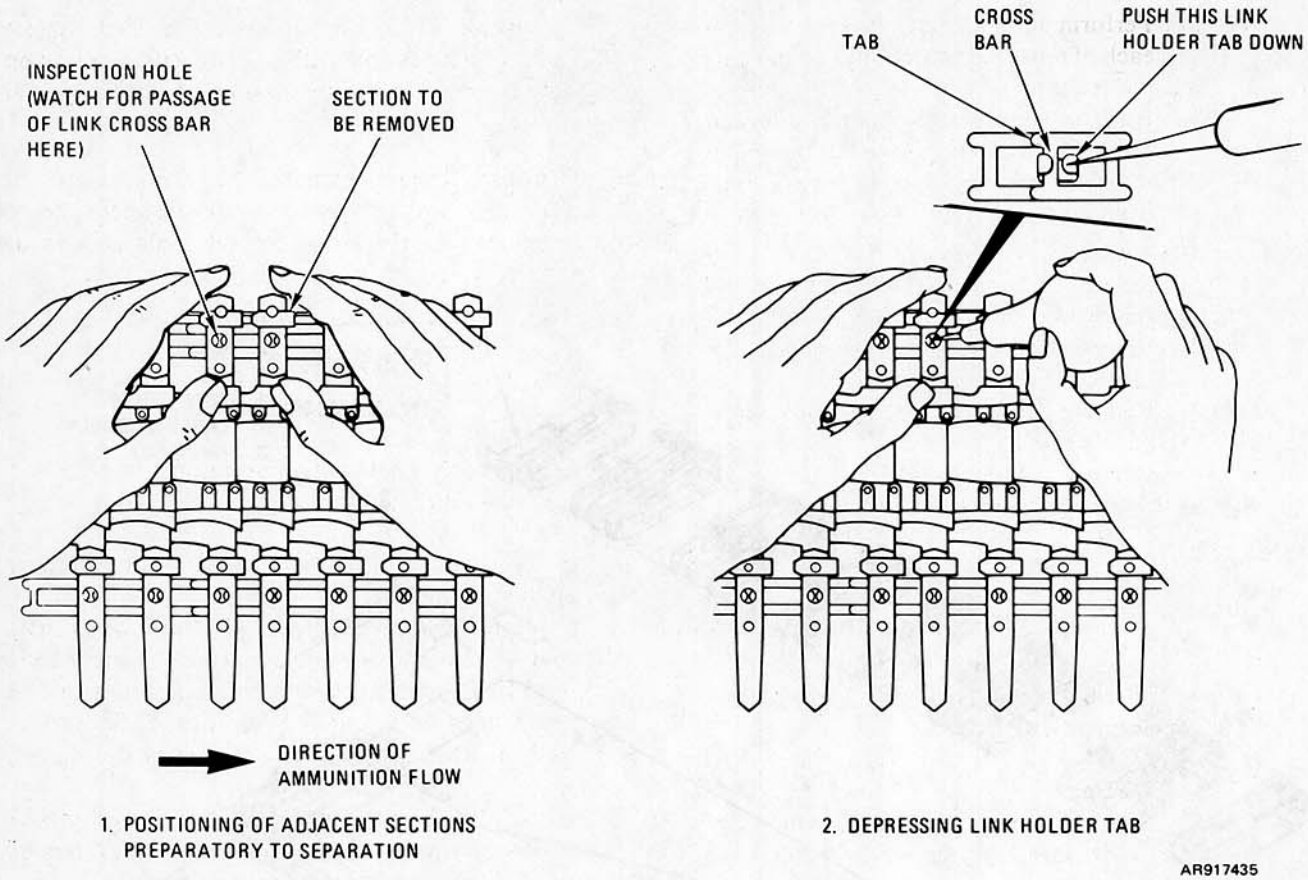


Figure 3-48. Disassembling Feed Chute

(2) Extend one chuting section, on either side of section to be removed, to full length.

NOTE

When removing a box end section, connecting link of box end must be removed from the first chuting section. In some instances, the first chuting section and the box end will come off together and must then be separated.

(3) While looking into inspection hole of section to be removed (1, fig. 3-48), compress sections until a crossbar of link connecting these sections can be seen passing across center of inspection hole.

NOTE

If crossbar of link has not passed center of hole when sections are tight together, proceed to step (4) below. If crossbar of link passed center of hole, proceed to step (5) below.

(4) Hold sections in this position and look on each side of section to be removed. If connecting link tabs are on left side of section, right hand link holder tab must be depressed in following step. If connecting link tabs are on right side of section, left hand link holder tab must be depressed in following step.

(5) Position link as shown in figure 3-48 (2). Press down firmly on applicable tab of link holder with an awl or other pointed tool and pull crossbar free.

(6) Perform steps (3) through (5) above for each of remaining three links connecting the sections.
(7) Perform steps (2) through (6) above at other end of section (or sections) to be removed. Remove section (or sections) from feed chute.

c. *Ammo Box.*
(1) Release two latches; then, disengage and remove bellmouth guide (1, fig. 3-49).
(2) Release four latches and remove cover (2) from box subassembly (3).
(3) Remove 12 screws (7) and 3 support panels (4).
(4) Remove instruction plates (5 and 6) for replacement only.

d. *Cover.*

NOTE

Remove items (7 through 25, fig. 3-50) for replacement only.

(1) Deleted.
(2) Remove two bolts (5), two washers (4), two bolts (29), two washers (30), and booster (1).
(3) Remove two bolts (27), two washers (28), two washers (32), two nuts (33) and adapter assembly (31).

e. *Booster.* Remove four bolts (1, fig. 3-51) and motor (2) from housing (3).

3-67. Cleaning. Clean parts in accordance with paragraph 3-5b and c.

CAUTION

Solvents such as acetone, toluene, or trimethylene oxide will not be used to clean polycarbonate (Lexan) ammunition feed system components.

3-68. Inspection.

a. Parts will be visually inspected and repaired or replaced if found to be defective. Parts will be cleaned prior to inspection in order to effectively accomplish a complete inspection.

b. Table 3-15 lists ammunition feed system components and possible defects at specified points on the component to assist in accomplishing the visual inspections.

3-69 Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection. Repair structural foam defects as follows:

WARNING

All repair work will be performed in a hood-ventilated area.

a. *Inspection of Defects.* Inspect for following types of surface defects:

(1) *Blisters.* Blisters that are larger than 0.030 inch in diameter or blisters that occur more than 10 times in a one square inch area are not permissible. A blister is defined as a rounded elevation of the surface with voids and boundaries that are more or less sharply defined.

(2) *Burned Areas.* Thermal decomposition and discoloration, usually charred in appearance, on an area of the surface are not permissible.

(3) *Chips and Surface Voids.* Areas where a small portion of the resin is missing from corners or edges are not permissible.

(4) *Foreign Inclusions.* Particles in the foamed plastic which are foreign to the composition are not permissible on the surface of the foamed plastic.

(5) *Pits, Craters, Pinholes, and Porosity.* Small depressions, which include pits, craters, pinholes, and porosity, on the surface of the foamed plastic that are larger than 0.030 inch in diameter and depth or that occur more than 10 times in any one square inch area are not permissible.

(6) *Cracks.* Rupture of the foamed plastic surface is not permissible.

(7) *Spalls.* Breaks, chips, or scaled off areas on the surface of the foamed plastic are not permissible.

(8) *Other Surface Characteristics.* Surface characteristics other than those specified above such as surface roughness and marbling of surface color are permissible.

b. *Surface Preparation.* The defective surface will be cleaned with solvent (item 6, App D) prior to repair.

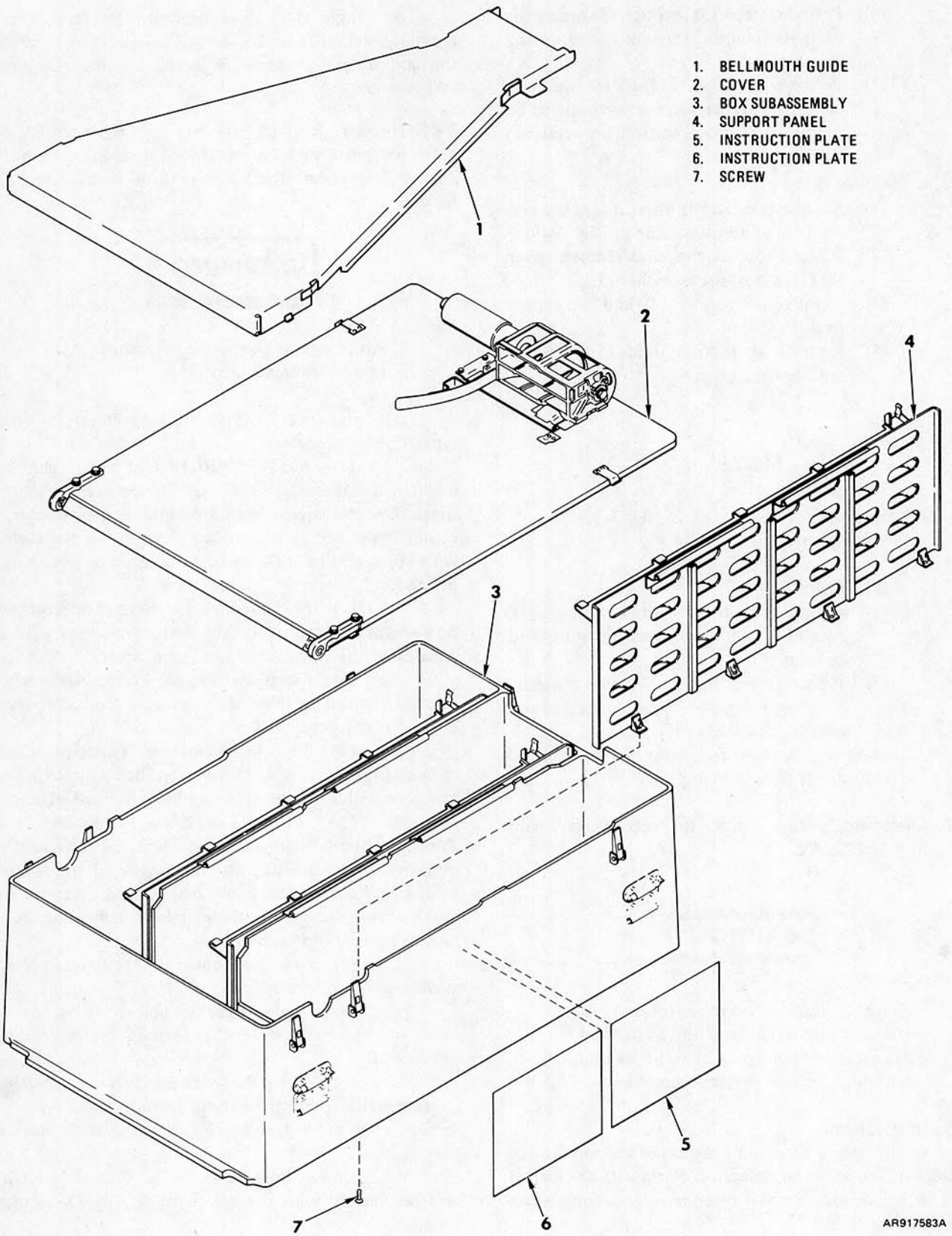


Figure 3-49. Ammo Box

1. BOOSTER
2. DELETED
3. DELETED
4. WASHER
5. BOLT
6. DELETED
7. BOLT
8. WASHER
9. BOLT
10. WASHER
11. HOOK
11.1 WASHER
12. NUT
13. NUT
14. ROLLER SUPPORT
15. BEARING
16. SQUARE ROLLER
16.1 WASHER
17. NUT
18. NUT
19. HOOK
20. BEARING
21. ROLLER SUPPORT
22. WASHER
23. BOLT
24. WASHER
25. BOLT
26. AMMO COVER
27. BOLT
28. WASHER
29. BOLT
30. WASHER
31. ADAPTER ASSEMBLY
32. WASHER
33. NUT

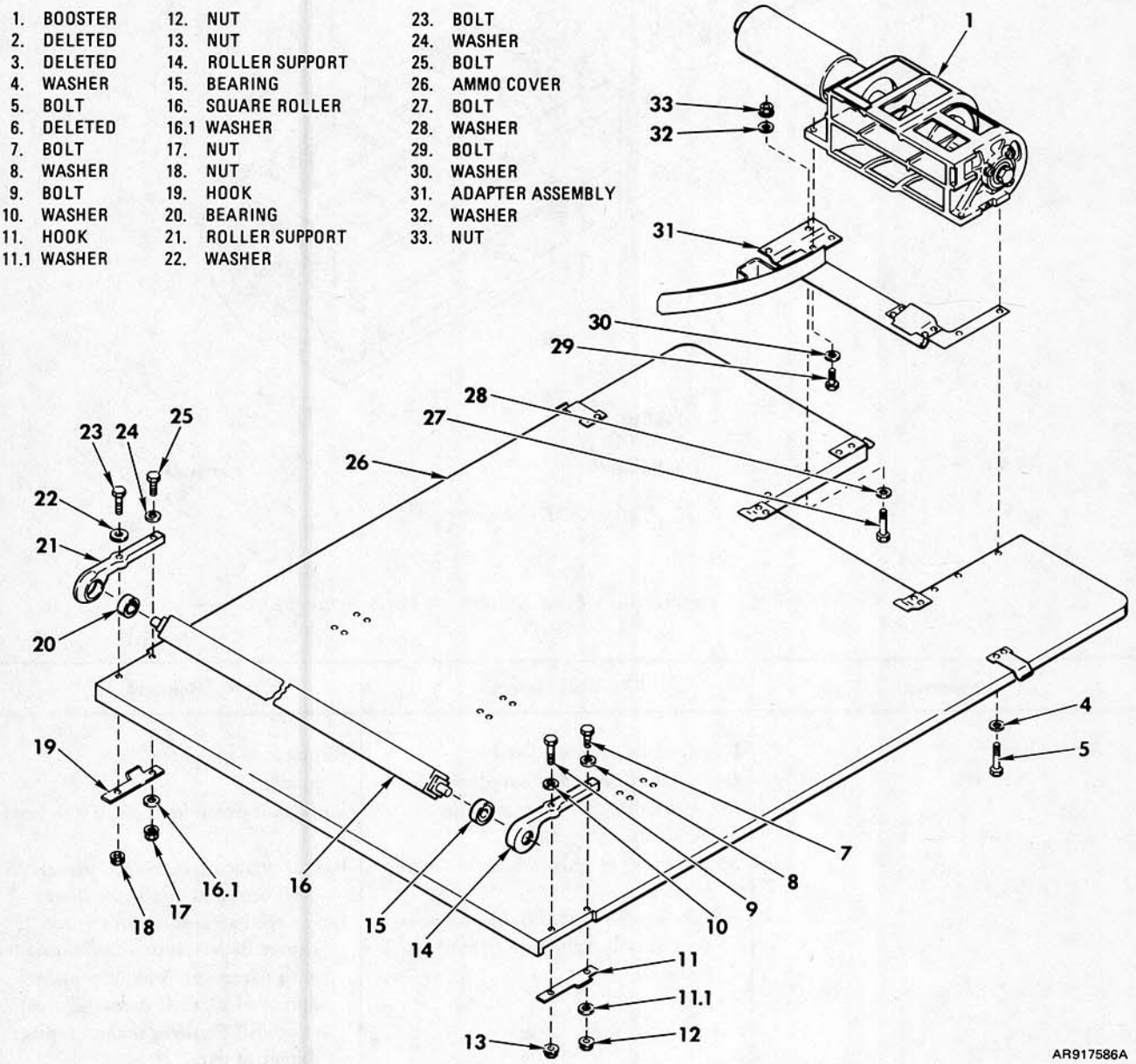
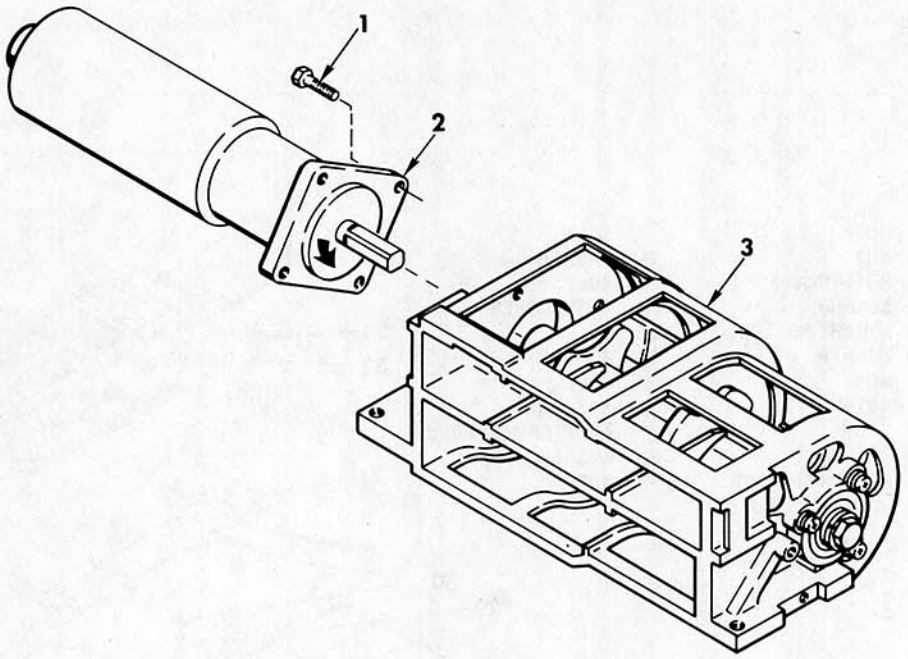


Figure 3-50. Cover



1 BOLT
2 MOTOR
3 HOUSING

AR917431C

Figure 3-51. Booster

Table 3-15. Ammunition Feed System — Parts Inspection

Component	Possible Defect	Remedy
Ammo box	Damaged or defective latches	Replace or straighten.
	Damaged or defective handles	Replace.
	Cracked or distorted ammo box bulkhead	Smooth if possible; replace if defective.
	Stress cracks in polycarbonate (lexan) material	Repair in accordance with paragraph 3-69 or replace defective part.
	Surface cracks caused by decomposition of polycarbonate (lexan) material	If damaged area does not exceed 25 square inches, repair in accordance with paragraph 3-69 or replace defective part. If damaged area exceeds 25 square inches, replace defective part.
Cover	Cracked or broken roller support	Replace.
	Cracked or binding bearings	Replace.
	Cracked or bent square roller	Replace.
	Bent brackets	Straighten or replace.
	Cracked or broken brackets	Replace.

Table 3-15. Ammunition Feed System — Parts Inspection — Continued

Component	Possible Defect	Remedy
Box cover	Damaged or defective hooks	Replace box cover or straighten.
	Damaged cover	Replace box cover.
	Stress cracks in polycarbonate (lexan) material	Repair in accordance with paragraph 3-69 or replace defective part.
	Surface cracks caused by decomposition of polycarbonate (lexan) material	If damaged area does not exceed 25 square inches, repair in accordance with paragraph 3-69 or replace defective part. If damaged area exceeds 25 square inches, replace defective part.
Rounds shield	Cracked or damaged angle	Replace.
	Cracked or damaged plate	Replace.
	Loose or missing rivets	Tighten or replace.
Bellmouth guide	Damaged or defective hooks	Replace bellmouth guide.
	Cracked or broken stiffener	Replace bellmouth guide.
	Bent or dented	Straighten or replace.
Booster drive cable	Damaged or defective	Replace.
Booster	**NOTE** Motor is designed so that shaft rotates freely in direction of arrow (see fig. 3-51). Rotation of shaft in opposite direction is difficult because entire gear train must be driven.	
Motor	Open or short circuit	Replace motor.
	Defective connector	Replace motor.
	Bent connector pins	Straighten.

c. *Void Repair.*

NOTE

A Kamweld Model 31-HT welder, or equivalent, is the recommended tool to use to repair structural foam defects. A 6-volt, 35-watt soldering iron, General Electric Company Model 3A203, or equivalent, may be used if a welder is not available.

(1) *Welder Setup.* Prepare welder for operation in accordance with manufacturer's instructions.

(2) *Soldering Iron Preheat.* Preheat a 35-watt soldering iron until tip will melt a section of scrap polycarbonate material having an approximate cross section of 0.25 x 0.25 inch (550° F to 590° F). Overheating will result in degradation of repair material.

(3) *Surface Preheat.* Hold repair tool close to surface to be repaired to warm surface.

NOTE

The use of molded polycarbonate material in accordance with 11831031 is recommended.

(4) *Repair.* Using repair tool, melt polycarbonate repair material. As soon as material is melted, transfer it to void area of foamed plastic. Continue to heat area of transfer until repair material bonds to foamed plastic surface; then, remove repair tool and cool repaired surface.

(5) *Buildup of Repair Material.* Repeat step (4) above until repaired surface is slightly higher than surrounding area.

(6) *Blending of Repaired Surface.* After repaired area has cooled and solidified, blend built-up repair material with the surrounding surface.

d. *Crack Repair (Cracks Not Completely Through Surface).*

(1) *Forming A "V" Section.* Using repair tool, melt foamed plastic at base of crack to form "V" section.

(2) *Filling "V" Section.* Fill "V" section in accordance with paragraph 3-69c above.

e. *Crack Repair (Cracks Completely Through Surface).*

(1) *Section Alignment.* Align sections on both sides of crack.

(2) *Preparing A "V" Section.* Using repair tool, melt foamed plastic at a point approximately halfway through material thickness and a distance equal to approximately one half material thickness from each end of crack. A "V" section will be formed by the melting of the foamed plastic.

(3) *Filling "V" Section.* Fill "V" section in accordance with paragraph 3-69c above.

(4) *Far Side of Through Crack.* Repeat steps (2) and (3) above.

f. *Repair of Fastener Holes.* When surface area adjacent to a fastener hole is damaged, repair damaged area as follows:

(1) *Surface Preparation.* Remove surface adjacent to fastener hole on fastener head side of cross section. The area removed will be conical in shape and will expose a foamed cross section using up to a maximum diameter of 1.0 inch on the fastener head side.

(2) *Filling Conical Opening.* Fill conical opening in accordance with paragraph 3-69c above.

3-70. Assembly.

a. *Deleted.*

b. Booster. Place motor (2, fig. 3-51) into position and secure with four bolts (1).

c. *Cover.*

(1) Place adapter assembly (31, fig. 3-50) into position on cover (26) and secure with two washers (28), two washers (32), two bolts (27), and two nuts (33).

(2) Deleted.

(3) Place booster (1) into position and secure with two bolts (29), two washers (30), two bolts (5), and two washers (4).

(4) If removed, assemble square roller (16), bearings (15 and 20), roller supports (14 and 21) and secure to cover (26) with bolts (7, 9, 23, and 25) and washers (8, 10, 22, and 24), hooks (11 and 19), washers (11.1 and 16.1) and nuts (12, 13, 17, and 18).

d. *Ammo Box.*

(1) If removed, replace instruction plates (5 and 6, fig. 3-49).

(2) Place three support panels (4) in position in box subassembly (3) and secure with 12 screws (7). Tighten 12 screws (7) to 15 to 20 lb-in. torque.

(3) Position cover (2, fig. 3-49) into place on box subassembly (3) and secure with four latches.

(4) Position bellmouth guide (1) into place on cover (2) and secure with two latches.

e. *Feed Chute.*

WARNING

Exercise care when working on feed chute. Sharp edges may cause injury.

(1) Place chuting section (or sections) to be joined on workbench. Orient sections so that direction of ammunition flow would be from left to right. Extend each section to its full length (fig. 3-48). See figure 3-53 for section quantities required.

(2) Place end of each track guide protruding from section on right under end of corresponding track guide on section at left so that guides overlap each other (fig. 3-54).

(3) Place end of each link protruding from section on left into position under frame of section at right so that crossbar of each link is inserted between section frame and tab of link holder (fig. 3-48).

(4) Push the two sections together.

(5) While holding the two sections together, look into each of the four inspection holes and check that crossbar of each link has passed completely over left hand tab of link holder and is snapped into position.

(6) If any of the four links has not snapped into position, move it into place by inserting an awl or other pointed tool behind left corner of left hand section frame and push on end of link.

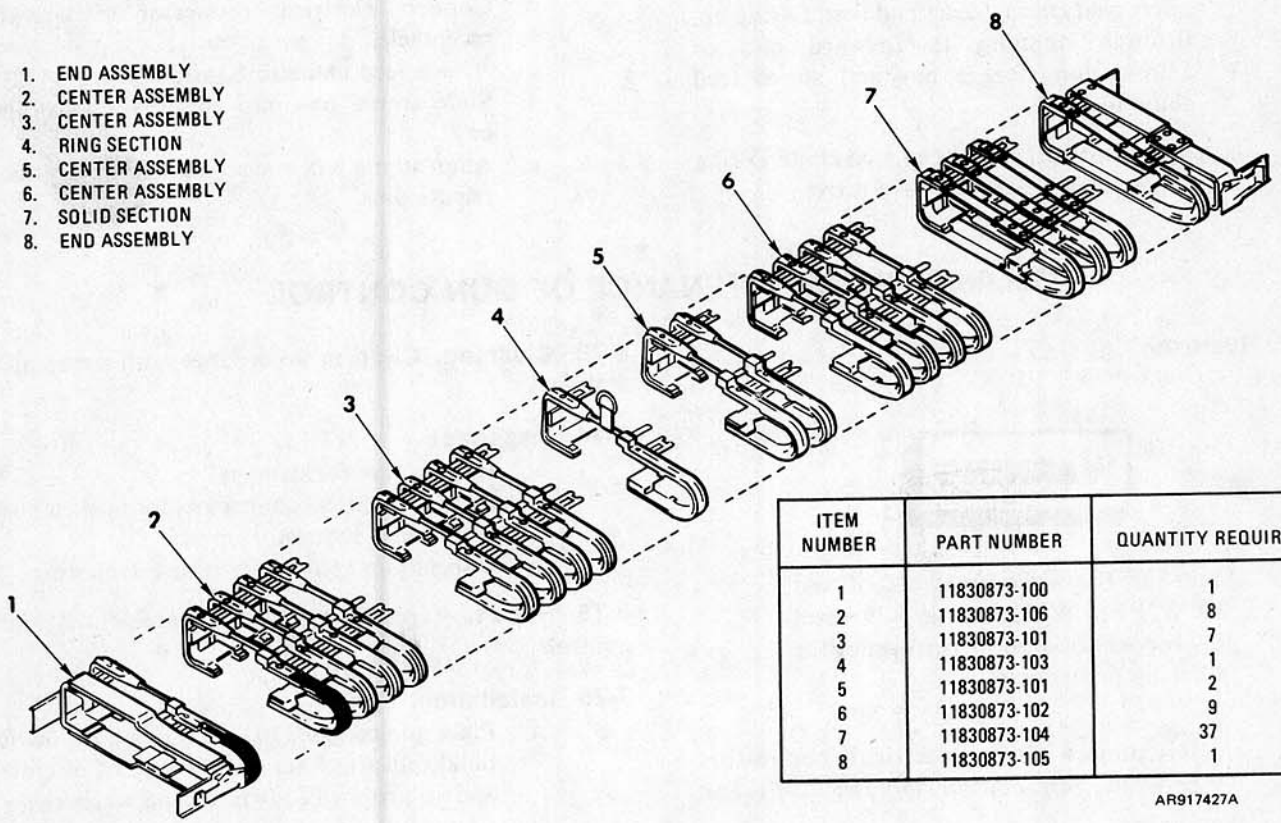
(7) Pull the two sections in opposite direction and check engagement of links in link holders. Reinsert any link that pulls free.

(8) Check that track guides are properly overlapped.

(9) Perform steps (2) through (8) above at other end of section (or sections) to be joined.

f. *Ammunition Feed System.* Connect cable assembly (2, fig. 3-47) to booster motor.

1. END ASSEMBLY
2. CENTER ASSEMBLY
3. CENTER ASSEMBLY
4. RING SECTION
5. CENTER ASSEMBLY
6. CENTER ASSEMBLY
7. SOLID SECTION
8. END ASSEMBLY



ITEM NUMBER	PART NUMBER	QUANTITY REQUIRED
1	11830873-100	1
2	11830873-106	8
3	11830873-101	7
4	11830873-103	1
5	11830873-101	2
6	11830873-102	9
7	11830873-104	37
8	11830873-105	1

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Figure 3-53. Feed Chute — Exploded View

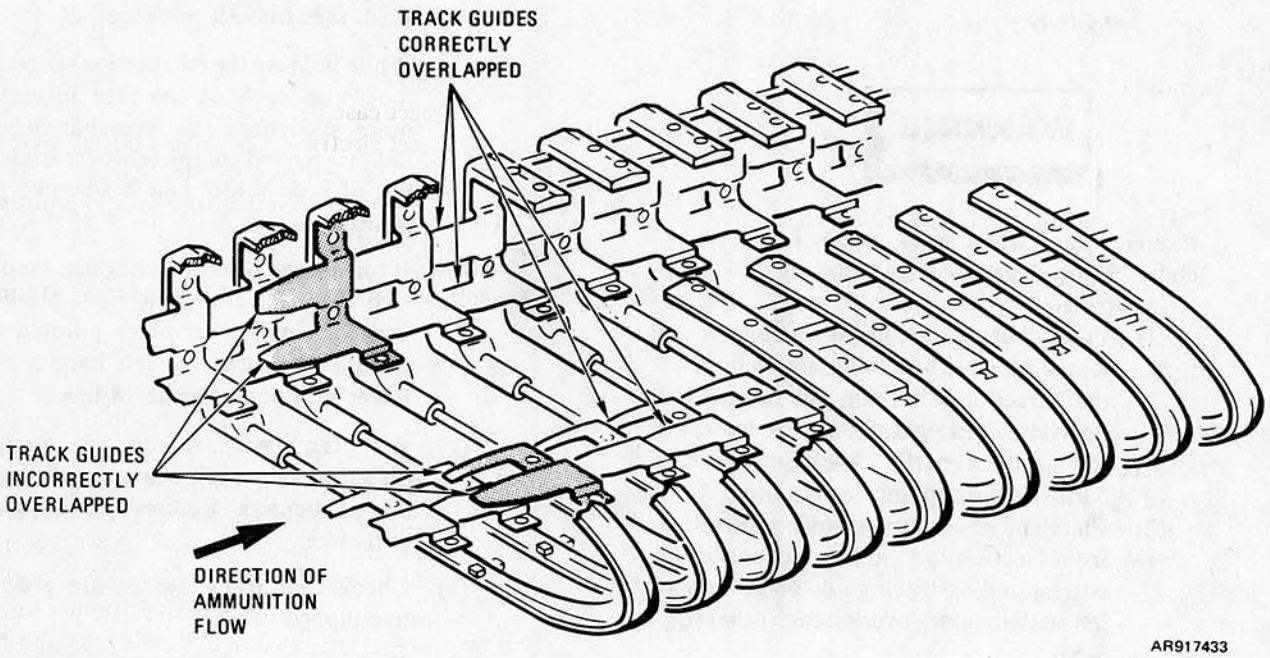


Figure 3-54. Track Guide Overlap

3-71. Installation.

a. Place feed chute (8, fig. 3-3) into aircraft through ammunition storage bay; then, insert feed chute, feeder end first, D-ring up, through opening in forward end of ammunition storage bay and attach feed chute to feeder.

b. Install spring (1) between feed chute D-ring and aircraft tie point above turret.

c. Place ammo box (7) and attached components on ammunition storage access door, either side.

d. Connect electrical connector to aircraft receptacle.

e. Attach feed chute to booster.

f. Slide ammo box into ammunition storage bay.

g. Align ammo box and secure with four quick-release pins.

Section XIII. MAINTENANCE OF GUN CONTROL

3-72. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Disconnect three electrical connectors between gun control (10, fig. 3-3) and aircraft.

b. Remove four mounting bolts, washers, and gun control from aircraft.

3-73. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-74. Inspection

a. Inspect case for damage.

b. Inspect electrical connectors for broken pins or cracked connector inserts.

c. Inspect gun control for secure mounting.

3-75. Repair. Repair consists of replacement of gun control.

3-76. Installation.

a. Place gun control (10, fig. 3-3) in position on bulkhead aft of turret, left side of aircraft, and secure with four bolts and washers.

b. Connect three electrical connectors between gun control and aircraft.

c. Check system operation. Refer to table 3-5.

Section XIV. MAINTENANCE OF TURRET CONTROL

3-77. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Remove aircraft panel above turret to gain access to turret control (17, fig. 3-3) and four of the five mounting screws.
b. Disconnect two clamps, four electrical connectors, and two leads between turret control and aircraft.
c. In the gunner cockpit remove screw and washer securing turret control.
d. Outside gunner cockpit remove four screws, four washers, and turret control from aircraft.

3-78. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-79. Inspection.

a. Inspect case for damage.
b. Inspect electrical connectors for broken pins or cracked connector inserts.
c. Inspect turret control for secure mounting.

3-80. Repair. Repair consists of replacement of turret control.

3-81. Installation.

a. Install turret control (17, fig. 3-3) into aircraft and secure with five screws. Install four screws from outside and one bolt from inside the gunner cockpit. Make certain screw installed from inside gunner cockpit measures no more than 1.031 inches long.
b. Connect four electrical connectors and two leads between turret control and aircraft and install two clamps.
c. Check system operation and boresight. Refer to table 3-5 and paragraph 2-4.
d. Install aircraft panel above right side of turret.

Section XV. MAINTENANCE OF LOGIC CONTROL

3-82. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Remove aircraft panel located below and just forward of the left wing.
b. Disconnect two electrical connectors between logic control (6, fig. 3-3) and aircraft.
c. Remove four mounting bolts, four washers and logic control from aircraft.

3-83. Disassembly. Disassembly consists only of removal of gun select switch knob (fig. 3-55) on front panel of assembly.

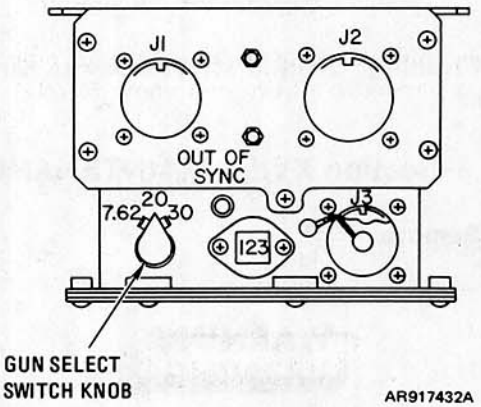


Figure 3-55. Logic Control Knob Location

3-84. Cleaning. Clean gun select switch knob in accordance with paragraph 3-5b and c.

3-85. Inspection.

a. Visually inspect switch knob for damage.
b. Inspect case for damage.
c. Inspect electrical connectors for broken pins or cracked connector inserts.
d. Inspect logic control for secure mounting.

3-86. Repair. Repair consists of replacement of defective switch knob or replacement of defective logic control.

3-87. Assembly. Assembly consists only of installing switch knob on front end of assembly (fig. 3-55).

3-88. Installation.

a. Place logic control (6, fig. 3-3) into position and secure with four bolts and four washers.
b. Connect two electrical connectors between aircraft and logic control.
c. Check system operation according to table 3-5.
d. Replace aircraft panel.

Section XVI. MAINTENANCE OF PRESSURE TRANSDUCER

3-89. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Remove aircraft panel located on left side of aircraft above ammo bay to gain access to pressure transducer (9, fig. 3-3).
b. Disconnect one electrical connector from pressure transducer.
c. Disconnect two pneumatic lines from pressure transducer.
d. Remove three screws, three washers and pressure transducer from aircraft.

3-90. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-91. Inspection.

a. Inspect pressure transducer for visible signs of damage.
b. Inspect pressure transducer for secure mounting.

3-92. Repair. Repair consists of replacement of pressure transducer.

3-93. Installation.

a. Place pressure transducer (9, fig. 3-3) in aircraft and secure with three screws and washers.
b. Connect two pneumatic lines to pressure transducer.
c. Connect one electrical connector to pressure transducer.
d. Check component operation. Refer to system checkout, table 3-5.
e. Install aircraft panel on left side of aircraft above ammo bay.

Section XVII. MAINTENANCE OF INTERFACE CONTROL UNIT (IFCU)

3-94. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Remove IFCU (5, fig. 3-3) access panel (right side, below wing).
b. Disconnect three electrical connectors from IFCU. protect receptacles and plugs with caps or electrical tape.
c. Remove mounting screws and washers, and remove IFCU from shelf.

3-95. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-96. Inspection.

a. Inspect IFCU case for cracks or damage.
b. Inspect electrical connectors for broken pins or cracked connector inserts.
c. Inspect IFCU for secure mounting.

3-97. Repair.

a. Tighten or replace loose or missing mounting screws.
b. Replace IFCU if case is damaged or defective.

3-98. Installation.

a. Position IFCU (5, fig. 3-3) in place on shelf and install mounting screws and washers.
b. Remove protective caps or electrical tape from three electrical connectors and install on IFCU.

Section XVIII. MAINTENANCE OF GUNNER CONTROL PANEL

3-99. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Disengage fasteners holding panel mounting.
b. Carefully lift gunner control panel (18, fig. 3-3) from mount.
c. Disconnect electrical connector(s).

3-100. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-101. Inspection.

a. Inspect panel for cracks or damage.
b. Inspect electrical connectors for broken pins or cracked inserts.
c. Inspect for damaged switches and controls.
d. Inspect panel for secure mounting.

3-102. Repair. Repair consists of replacement of the gunner control panel.

3-103. Installation.

a. Connect electrical connector(s).
b. Position gunner control panel (18, fig. 3-3) in mount, being careful not to damage wiring. Engage fasteners.
c. Apply power and check components for proper operation.

Section XIX. MAINTENANCE OF PILOT CONTROL PANEL

3-104. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (see fig. 3-39, sheet 2) is disconnected before performing the following procedures.

a. Disengage fasteners holding panel mounting.
b. Carefully lift pilot control panel (3, fig. 3-3) from mount.
c. Disconnect electrical connector(s).

3-105. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-106. Inspection.

a. Inspect panel for cracks or damage.
b. Inspect electrical connectors for broken pins or cracked inserts.
c. Inspect for damaged switches and controls.
d. Inspect panel for secure mountings.

3-107. Repair. Repair consists of replacement of the pilot control panel.

3-108. Installation.

a. Connect electrical connector(s).
b. Position pilot control panel (3, fig. 3-3) in mount, being careful not to damage wiring. Engage fasteners.
c. Apply power and check components for proper operation.

Section XX. MAINTENANCE OF REFLEX SIGHT E

3-109. Description. The reflex sight is located above the pilot instrument panel. It provides a projected reticle image for the pilot to use when firing the wing stores or turret weaponry from a target collision course. For the wing stores, the pilot uses the elevation/depression knob and ballistic data cards for obtaining ballistics information. For turret weaponry, the range potentiometer is used for superelevation.

3-110. Removal. Remove reflex sight in reverse order of installation (paragraph 3-114).

3-111. Disassembly/Assembly. Disassemble the reflex sight in accordance with the sequence shown in figures 3-56 and 3-57. Assembly is the reverse order of disassembly.

3-112. Adjustments.

a. *Beamsplitter Adjustment.* After replacing beamsplitter (29, fig. 3-57), perform elevation/depression knob adjustment as follows:

(1) Apply power to reflex sight with circuit breaker and switch settings as prescribed in TM 55-1520-236 series manuals. Move the elevation/depression knob on the pilot reflex sight. Observe that the reticle tracks the centerline of the boresight target. if the reticle does not track parallel to the centerline of the boresight target, adjust the support assembly mounting shims, as necessary, until the sight tracks the target centerline. Also observe the location of sight reticle vertical marker in respect to vertical line of target. If sight vertical marker and target vertical line do not coincide, proceed as follows:

(a) Loosen clamping screw in sight head bearing ring.

(b) Turn head until vertical reticle marker is superimposed on vertical line of target.

NOTE

Head may be turned approximately 10 mils in either direction without causing excessive reticle tilt. When excessive tilt results before superimposition is accomplished, the support assembly is not aligned to the aircraft centerline.

(c) Tighten clamping screw.

NOTE

The above is the check and correction for zero line of sight in azimuth.

(2) Turn the elevation/depression knob on the pilot sight to the zero mil setting. observe that the reticle pip falls on the pilot sight boresight position of the boresight target. If the reticle pip does not fall on the target as specified, proceed as follows:

(a) Turn the elevation/depression knob on the pilot sight until the reticle falls on the pilot sight boresight position of the boresight target. Observe the mil setting of the elevation/depression adjustment. If the scale is within the limit of +20 to —20 mils, remove the center mounting screw, move the scale disc to zero, and tighten the screw.

(b) If the reading indicated in (a) above is more than +20 to —20 mils, adjust the support assembly mounting shims as necessary until the reticle falls on the pilot sight boresight position.

b. *Zeroing the Inclinometer.* After replacement, zero inclinometer (20) as follows:

(1) Remove reflex sight from support assembly (para 3-110).

(2) Attach reflex sight to an angle plate which is set up on a level surface plate.

(3) Loosen screws (22, fig. 3-57) securing inclinometer (20) to reflex sight.

(4) Position the inclinometer to indicate level, then tighten screws (22, fig. 3-57).

3-113. Cleaning, Inspection, and Repair.

a. *Cleaning.*

(1) Remove excess grease and oil from mechanical components with waste wiping cloths or soft bristle brush saturated with solvent (item 5, App 5) or mineral spirits paint thinner (item 6, App D). Allow to dry. Wipe connectors and electrical components with a clean, dry, lint-free cloth or soft bristle brush.

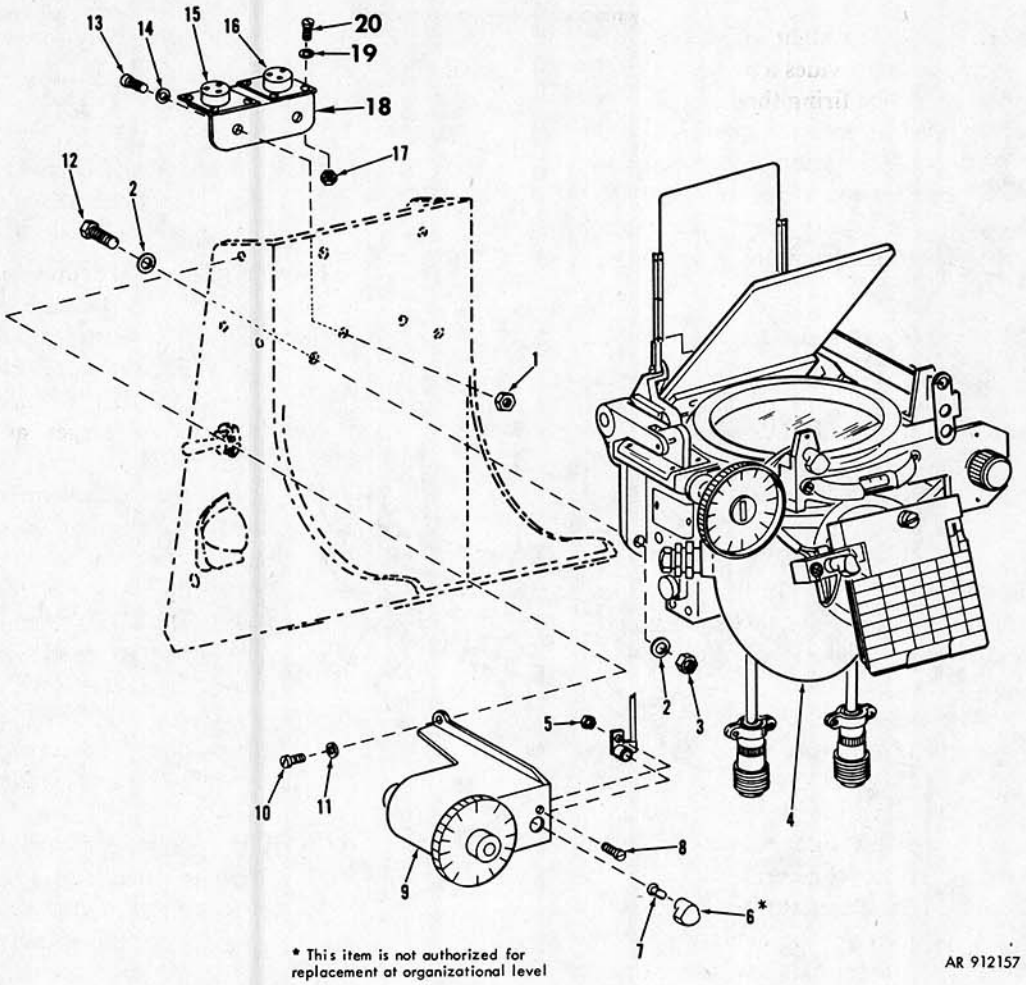


Figure 3-56. Reflex Sight Assembly — Partially Exploded View

Legend for figure 3-56:

1	Nut	11	Washer
2	Washer	12	Bolt
3	Nut	13	Screw
4	Reflex sight	14	Washer
5	Nut	15	Connector
6	Shield	16	Connector
7	Lamp	17	Nut
8	Screw	18	Bracket
9	Range potentiometer assembly	19	Washer
10	Screw	20	Screw

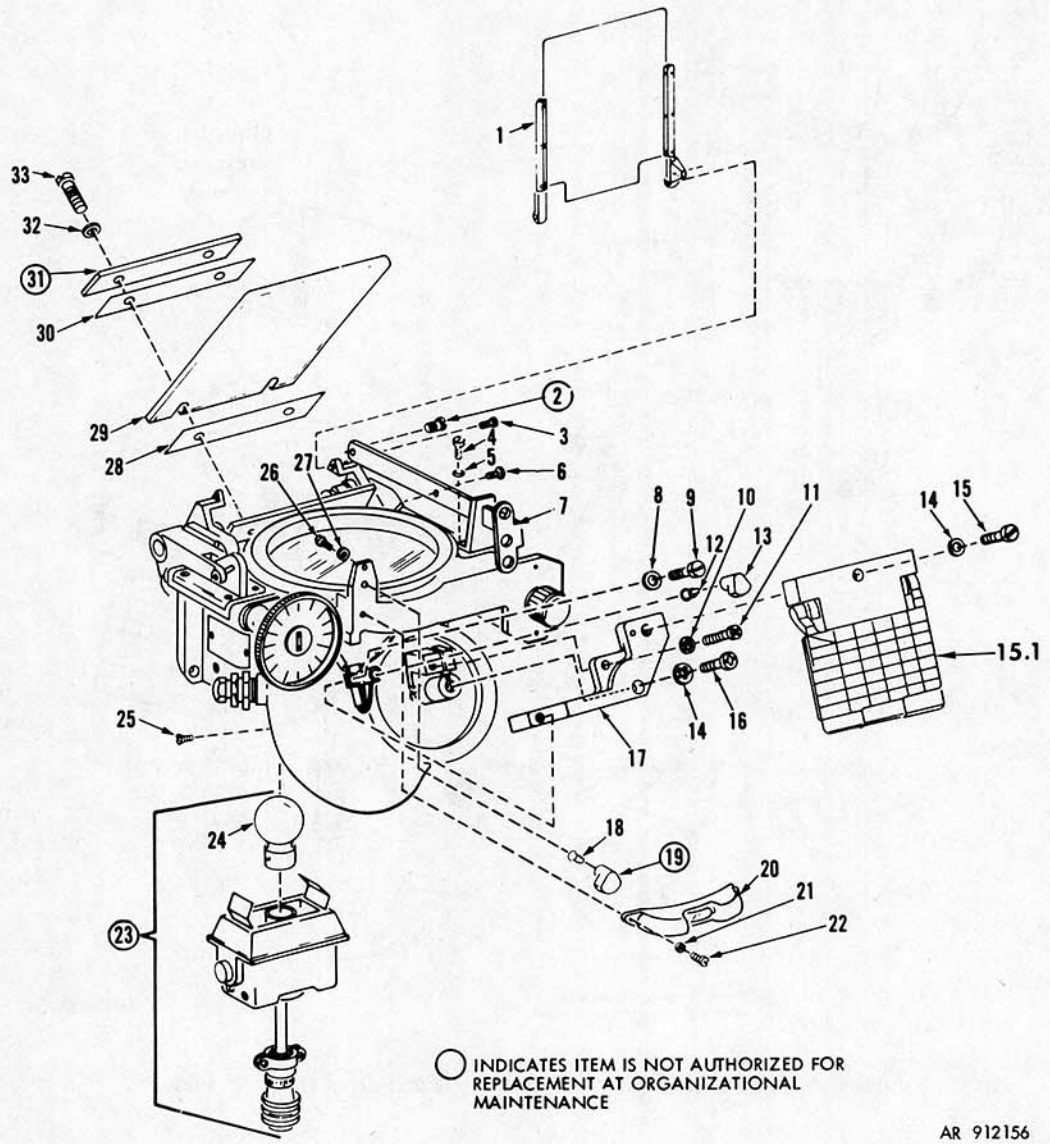


Figure 3-57. Reflex Sight — Partially Exploded View

Legend for figure 3-57:

1	Riveted filter	13	Shield	24	Lamp
2	Screw	14	Washer	25	Screw
3	Screw	15	Screw	26	Screw
4	Screw	15.1	Elevation card assembly	27	Washer
5	Washer	16	Screw	28	Gasket
6	Screw	17	Adapter	29	Optical instrument beamsplitter
7	Lever	18	Lamp	30	Gasket
8	Washer	19	Shield	31	Plate
9	Screw	20	Inclinometer	32	Washer
10	Washer	21	Washer	33	Screw
11	Screw	22	Screw		
12	Lamp	23	Lamp housing assembly		

(2) Remove dust or other foreign material from optical elements, using a camel-hair brush. Clean smears, dirt, or smudges by using lens paper or ethyl alcohol.

b. *Inspection.* Inspect components for dirt, excessive grease or oil, metal filings, solder waste, or other foreign matter. Inspect for cracked or damaged optical components. Inspect optical components for accumulation of moisture. Purge and charge reflex sight (para c(2) below) if moisture is present. Inspect for broken or frayed wiring.

c. *Repair.*

(1) *General.* Replace damaged or malfunctioning components.

(2) *Purging and Charging.* To purge and charge the reflex sight to remove accumulations of moisture, refer to figure 3-58 and proceed as follows:

WARNING

Do not drop containers of compressed nitrogen gas. Under no circumstances exceed the pressures indicated below. Make certain the cylinder contains dry nitrogen.

(a) Obtain a cylinder of dry nitrogen and remove threaded protective cover from outlet of cylinder. Open valve momentarily to rid valve seat of any foreign matter.

(b) Check nitrogen filling adapter for cleanliness and proper seating of gasket. Securely attach adapter to cylinder valve and then secure pressure regulator to adapter.

(c) Remove cap from low pressure port of regulator and securely attach hose assembly to same port.

(d) Rotate pressure regulator valve counterclockwise to extreme closed position.

(e) Open nitrogen cylinder valve slowly until pressure is registered on high pressure gage.

NOTE

If pressure indicated is less than 100 psi, obtain and use replacement cylinder.

(f) Slowly rotate pressure regulator valve clockwise until approximately 5 psi is registered on low pressure gage. Check for and eliminate any interference. Close pressure regulator valve.

(g) Securely attach free end of hose assembly to purging valve on reflex sight.

(h) Open pressure regulator valve until 5 psi is registered on low pressure gage. Remove screw from air outlet on reflex sight and allow pressure to flush through assembly for 5 minutes or until all traces of moisture have been removed.

(i) Reduce pressure to between 0.5 and 1.0 psi.

(j) Install screw to close air outlet in reflex sight.

(k) Continue to charge reflex sight t 0.5 to 1.0 psi for 2 minutes.

(l) Close regulator and cylinder valve. Remove hose assembly from reflex sight purging valve and replace cap.

3-114. Installation. The procedures for installation/removal of the reflex sight are as follows:

a. *Installation.*

(1) Use lever on sight to release filter to near horizontal position, turn elevation/depression knob to position beamsplitter as near horizontal as possible.

(2) Position sight on face of support mounting plate and secure in position. Install four bolts, washers, and nuts distributing torque evenly.

(3) Using three screws and lock washers supplied with sight, attach range potentiometer to left side of support assembly and connect aircraft cable assembly to range potentiometer electrical connector. Using screw and nut supplied with sight, attach the free panel light to range potentiometer.

(4) Using two screws supplied with sight, attach connector bracket (panel lights and reticle light) to right side of support assembly. Install support assembly connectors in the bracket and connect the two sight connectors.

(5) Lower mounting plate of support assembly enough to allow positioning of sight beamsplitter and filter in operating

position. Set sight elevation/depression knob and range potentiometer scale to 0. Reposition support mounting plate so vertical center of sight beamsplitter is approximately 7 inches down from aircraft canopy. Lock plate in position.

b. *Alignment.* Alignment of reflex sight is accomplished during boresighting.

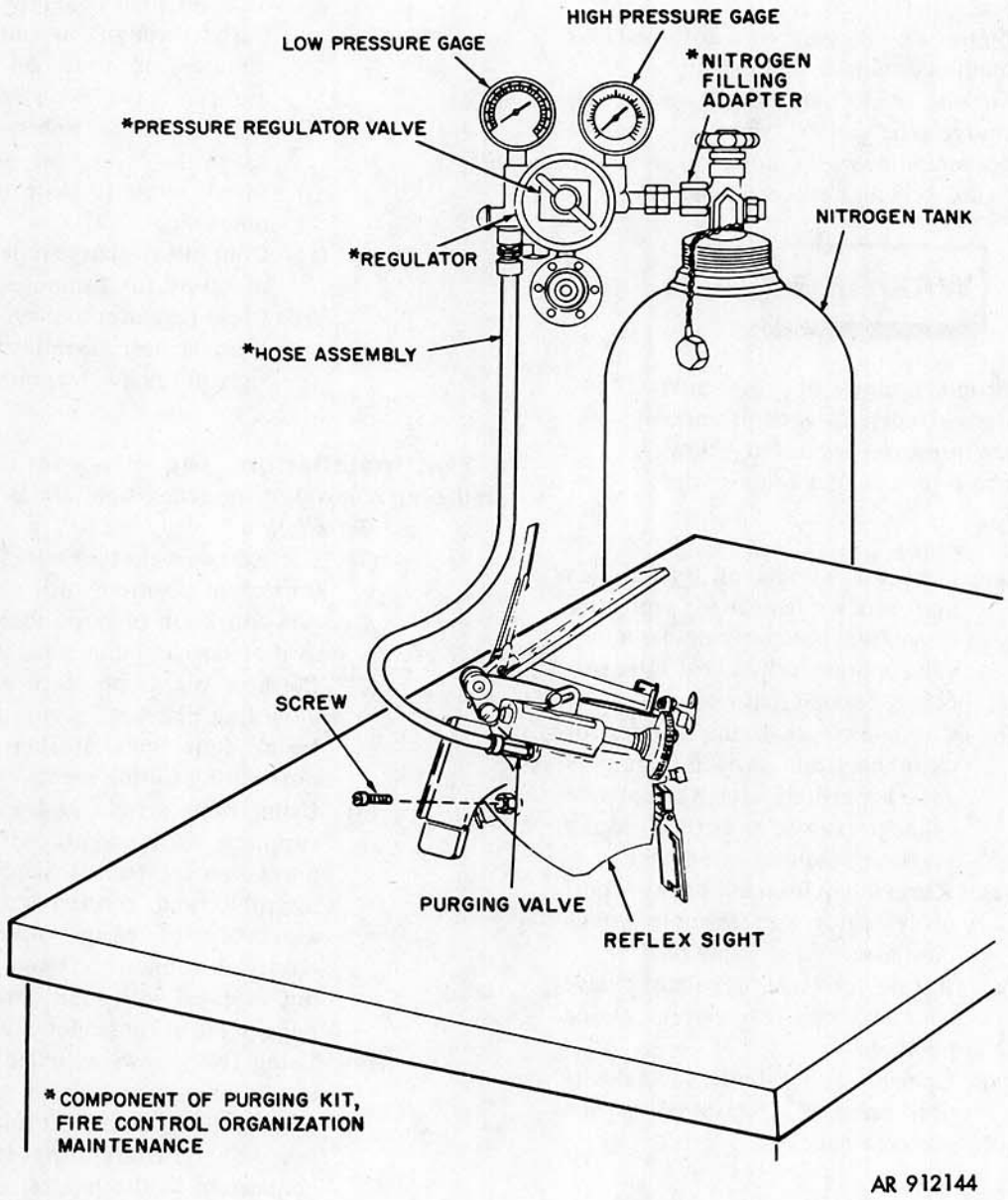


Figure 3-58. Purging and Charging of Reflex Sight

Section XXI. MAINTENANCE OF REFLEX SIGHT SUPPORT ASSEMBLY AND RANGE POTENTIOMETER

3-115. General. This section contains instructions for disassembly, assembly, cleaning, inspection, and repair of reflex sight support assembly and range potentiometer.

3-116. Disassembly/Assembly

a. *Support Assembly.* Not authorized at unit maintenance level.

b. *Range Potentiometer.* Disassemble the range potentiometer in accordance with figure 3-59. Assembly is the reverse order of disassembly.

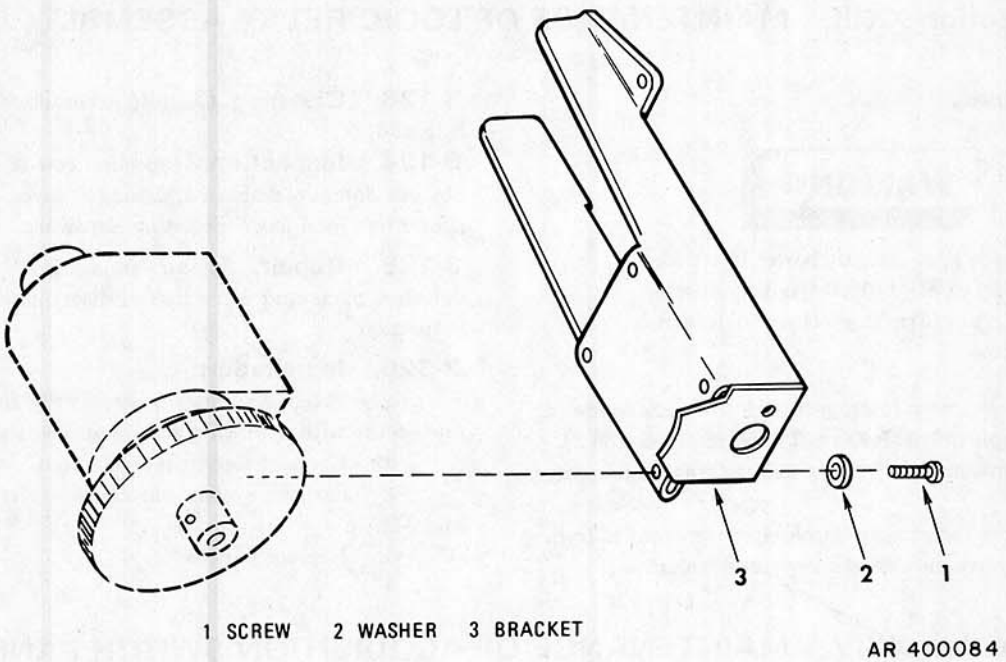


Figure 3-59. Range Potentiometer Assembly

Section XXII. MAINTENANCE OF TURRET BUFFER AMPLIFIER. M

3-117. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

a. Remove left turret fairing.

b. Disconnect two electrical connectors from turret buffer amplifier.

c. Remove mounting screws and washers, and remove turret buffer amplifier from aircraft.

3-118. Cleaning. Clean in accordance with paragraph 3-5b. and c.

3-119. Inspection. Inspection consists of checking for obvious damage, cracked or damaged electrical connectors, and loose mounting hardware.

3-120. Repair. Repair consists of replacement of turret buffer amplifier.

3-121. Installation.

a. Place turret buffer amplifier (9.2 fig. 3-3) in aircraft and secure with mounting screws and washers.

b. Connect electrical connectors.

c. Perform system checkout (refer to Tables 3-5 and 3-6).

d. Replace left turret fairing.

Section XXIII. MAINTENANCE OF LOGIC RELAY ASSEMBLY. M

3-122. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

a. Remove lower fuselage panel from underside of ammunition compartment. Refer to TM 55-1520-236/239-23.

b. Disconnect electrical connectors from logic relay assembly.

c. Support logic relay assembly to prevent it from dropping and remove mounting screws and washers.

3-123. Cleaning. Clean in accordance with paragraph 3-5b and c.

3-124. Inspection. Inspection consists of checking for obvious damage, cracked or damaged cover, relays, electrical connectors, and loose mounting hardware.

3-125. Repair. Repair consists of replacement of defective parts and correction of discrepancies noted during inspection.

3-126. Installation.

a. Place logic relay assembly (9.1 fig. 3-3) in aircraft and secure with mounting screws and washers.

b. Connect electrical connectors.

c. Perform system checkout (refer to Tables 3-5 and 3-6).

d. Replace panel.

Section XXIV. MAINTENANCE OF ACQUISITION SWITCH PANEL.

3-127. Removal.

WARNING

Make sure that aircraft power is off and that W2P1 to W3J1 (fig. 3-4) is disconnected before performing the following procedures.

a. Remove acquisition switch panel from gunners instrument panel by removing attaching screws.

b. Pull switch panel slightly out of instrument panel and disconnect M (desolder E) wires from switch terminals.

3-128. Disassembly/Assembly. Disassemble the acquisition switch panel by removing nut securing switch to panel and removing switch from panel. Assemble the acquisition switch by positioning switch in place and secure with nut.

3-129. Repair. Repair consists of replacing acquisition switch panel and/or switch.

3-130. Installation.

a. Connect M (solder E) switch wires to switch terminals (Refer to fig. 3-2.2).

b. Position acquisition switch panel in place on gunners instrument panel and secure with attaching screws.

CHAPTER 4

MAINTENANCE OF AUXILIARY EQUIPMENT

Section I. MAINTENANCE OF UNIVERSAL BORESIGHT KIT

4-1. General. Maintenance of the universal boresight kit is limited to inspection, cleaning, and replacement of parts authorized for aviation unit maintenance.

4-2. Disassembly.

a. The universal boresight kit (fig. 4-1) consists of the fiber scope, telescope, and carrying case which require no disassembly and three adapters which can be disassembled.

b. Disassembly of an adapter consists of disengaging the streamer S-hook from the adapter and separating the parts.

4-3. Cleaning. Refer to paragraph 3-5b and c for cleaning instructions.

4-4. Inspection. Inspection will consist of a visual examination for obvious defects such as cracked or broken parts or components.

4-5. Repair. Repair will consist of replacement of defective parts.

4-6. Assembly. Assembly of an adapter consists of engaging the streamer S-hook to the adapter to join the parts.

Section II. MAINTENANCE OF 20-MM BARREL EROSION GAGE KIT

4-7. General. Maintenance of the 20-mm barrel erosion gage kit is limited to inspection, cleaning, and replacement of parts authorized for aviation unit maintenance.

4-8. Disassembly. Disassembly of the 20-mm barrel erosion gage kit is limited to removal of the parts identified in figure 4-2.

4-9. Cleaning. Refer to Chapter 3, paragraph 3-5b and c for cleaning instructions.

4-10. Inspection. Inspection will consist of a visual examination for missing or damaged parts.

4-11. Repair. Repair will consist of replacement of missing or defective parts.

4-12. Assembly. Assembly of the 20-mm barrel erosion gage kit consists of installing the parts identified in figure 4-2.

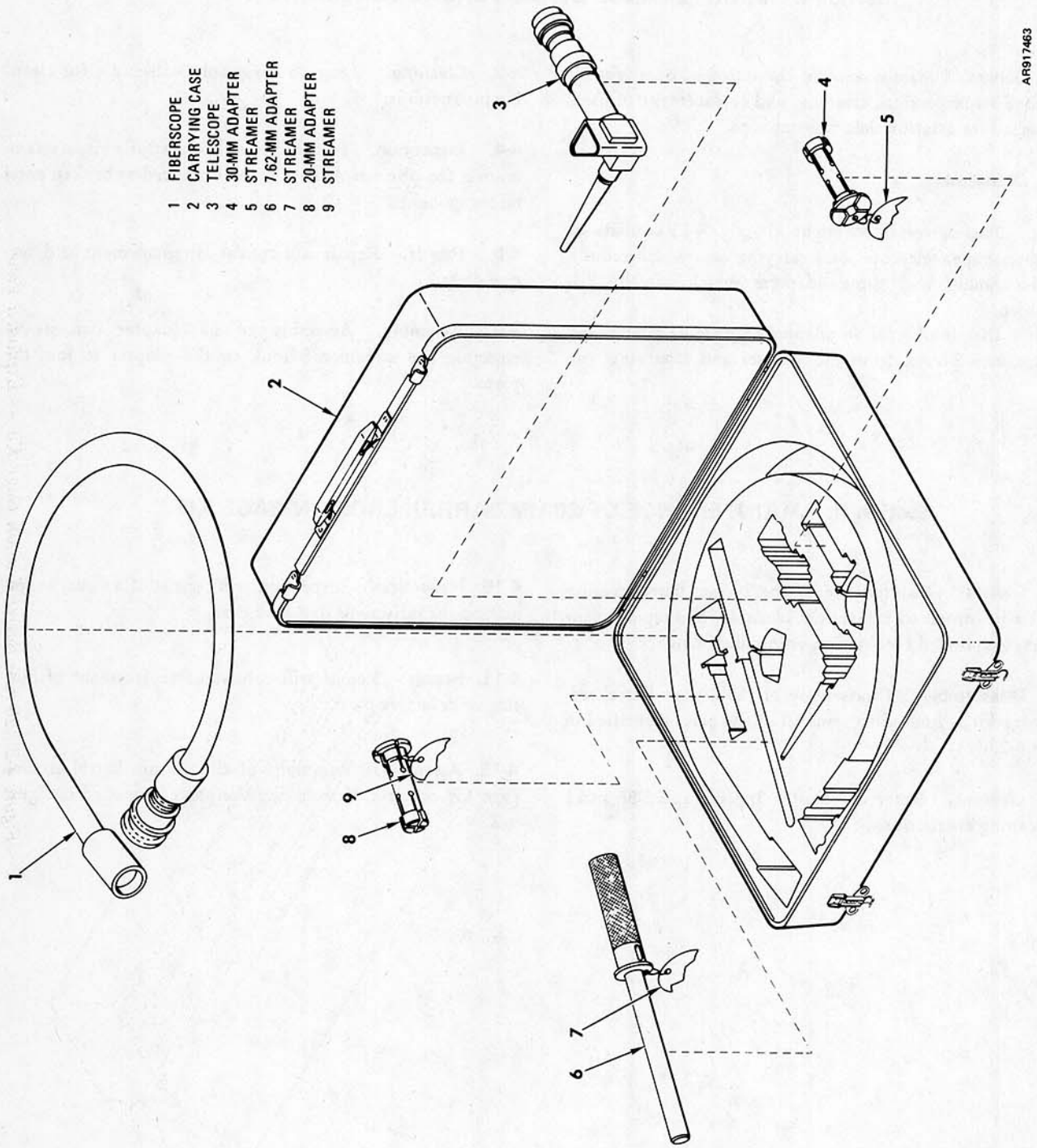


Figure 4-1. Universal Boresight Kit — Exploded View

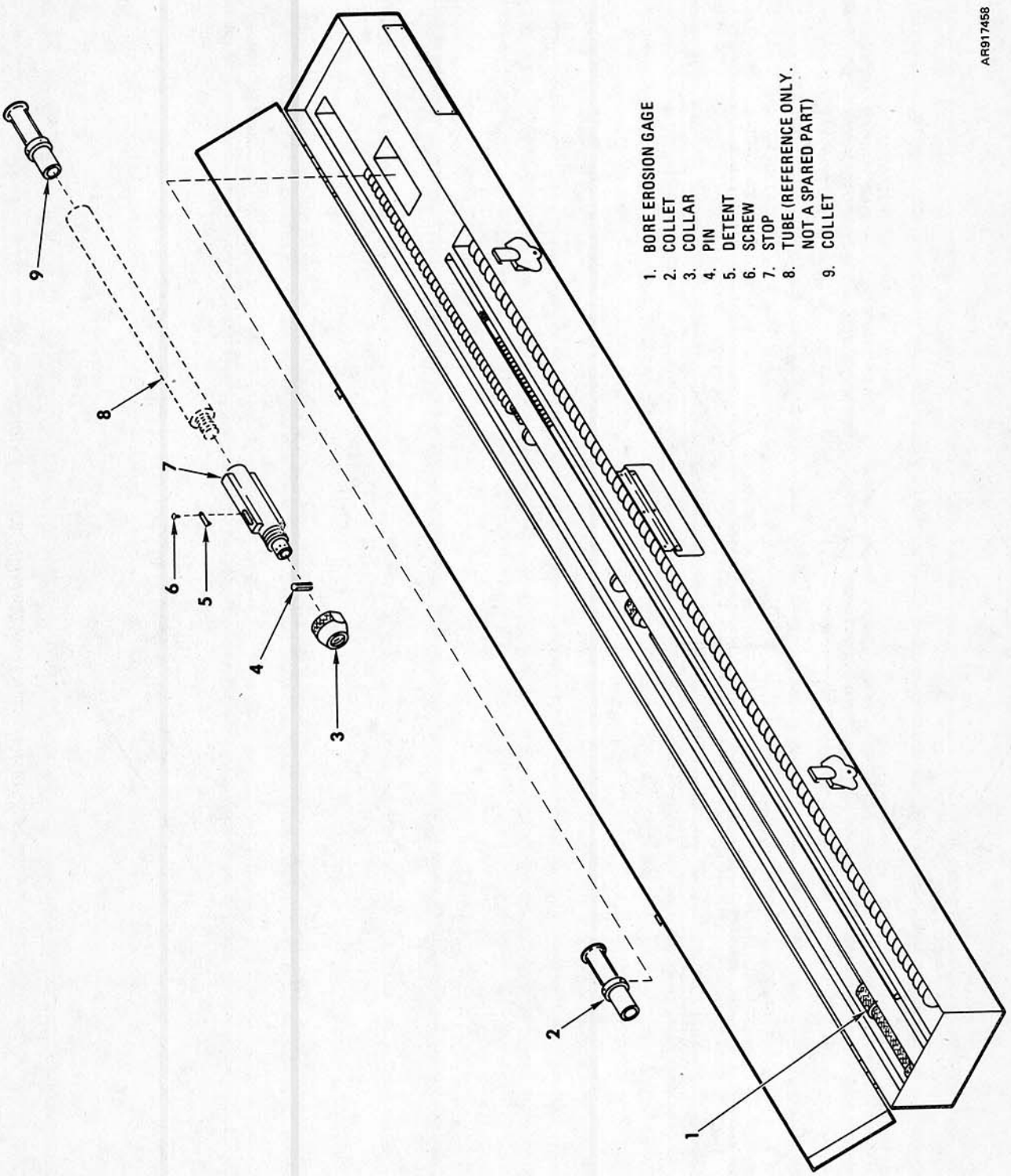


Figure 4-2. 20-mm Barrel Erosion Gage Kit — Exploded View

CHAPTER 5

AMMUNITION

Section I. GENERAL

5-1. General. This chapter contains a description 20-mm ammunition intended for use with the UTS. National stock numbers and pertinent data for the standard ammunition are listed in SC-1305/30IL.

WARNING

Rechambering of live ammunition is prohibited. The use of previously chambered cartridges may result in damage to equipment or injury to personnel due to cartridge hangfire. Propellant-primer contamination, a cause of hangfire, can occur because the chambering action may loosen the projectile in the cartridge case and break the waterproof seal. Any cartridges that have been chambered and later extracted unfired will be disposed of in accordance with TM 9-1300-206 and/or local regulations.

5-2. Description and Identification. The ammunition is painted and color coded to provide a handy means of identification. Caliber, type, model, and lot number are marked on the projectiles. Table 5-1 shows the types and color codes. The ammunition types are further described in the following paragraphs.

Table 5-1. Ammunition Types and Color Codes

Kind of Ammunition	Color of Projectile	Color of Marking
HEIT-SD M246 (high-explosive incendiary tracer-self destruct)	Yellow w/brown and red bands	"T" in red, rest of markings black
HEI, M56A-3 (high-explosive incendiary)	Yellow w/red band	Black
TP-T, M220 (target practice-tracer)	Blue	"T" in orange, rest of markings in white
TP, M55A2 (target practice)	Blue	White
Dummy, M51A2	Chromate	Metal Stamping

a. *High-Explosive Incendiary With Tracer Self-Destroying* (HEIT-SD), M246 (fig. 5-1). This cartridge is assembled with an M505A3 point detonating (PD) fuze. The projectile, in addition to the M505A3 fuze, consists of an HEI charge, self-destruct relay charge, and a tracer

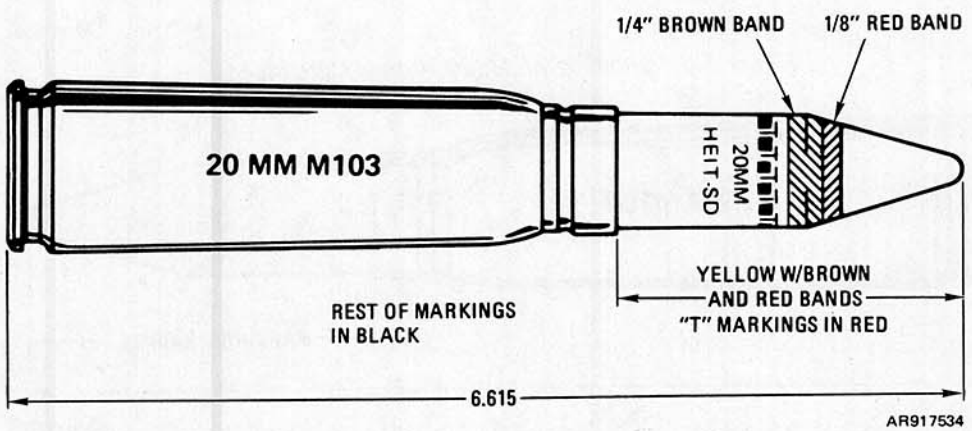


Figure 5-1. Marking of M246 20-mm Cartridge

charge. These charges form the self-destruct chain. The tracer burns for about 3 to 7 seconds, whereupon the relay charge is ignited which detonates the HEI charge low order. If impact with a target occurs, prior to self-destruction, the M505A3 fuze causes the HEI charge to detonate high order. This cartridge is for use against aerial targets.

b. *High-Explosive Incendiary* (HEI), M56A3 (fig. 5-2). This cartridge is for use against ground targets, including lightly armored vehicles, functioning with both explosive and incendiary effect. The projectile consists of an HEI charge and is assembled with the M505A3 fuze. The M505A3 fuze is a point-detonating, single-action fuze intended to function on impact with the target.

c. *Target Practice – Tracer* (TP-T), M220 (fig. 5-3). This cartridge is for practice and training. The projectile is similar to the M56A3 projectile, but has no HEI charge and is assembled with a dummy fuze. The projectile does contain a tracer composition which burns visibly for a minimum of 1.9 seconds.

d. *Target Practice* (TP, M55A2 (fig. 5-4). This cartridge is for practice and test firings. The projectile is similar to the M56A3 projectile, but is hollow and contains no HEI charge or tracer.

e. *Dummy* M51A2 (fig. 5-5). The dummy is a completely inert assembly used for filling the conveyor system during shipment or storage and for nonfiring system checkout.

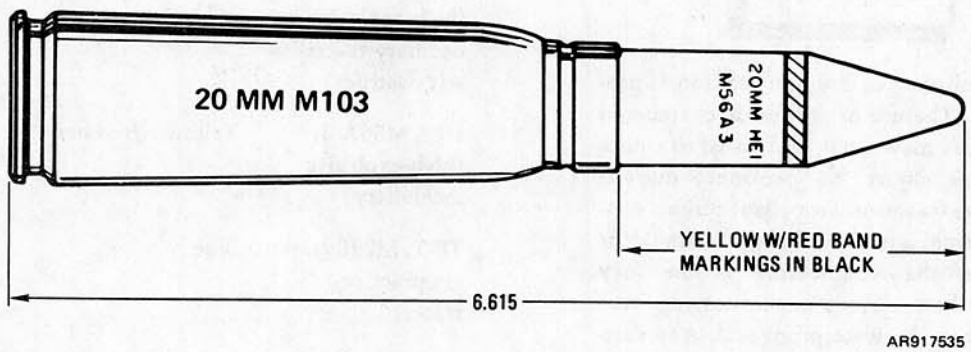


Figure 5-2. Marking of M56A3 20-mm Cartridge

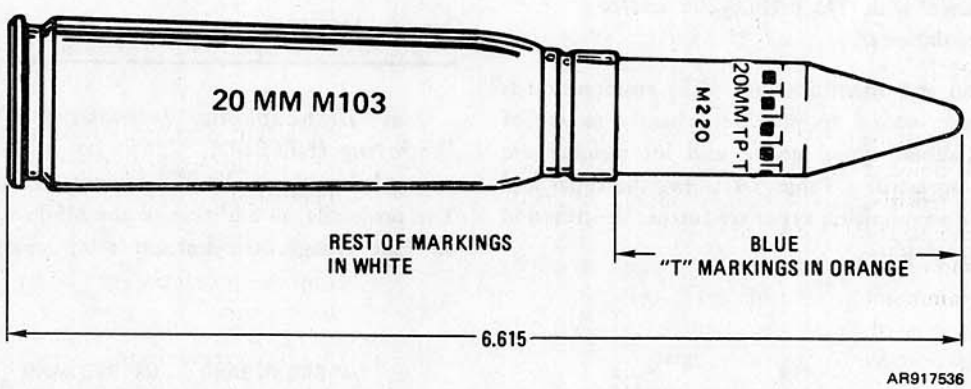


Figure 5-3. Marking of M220 20-mm Cartridge

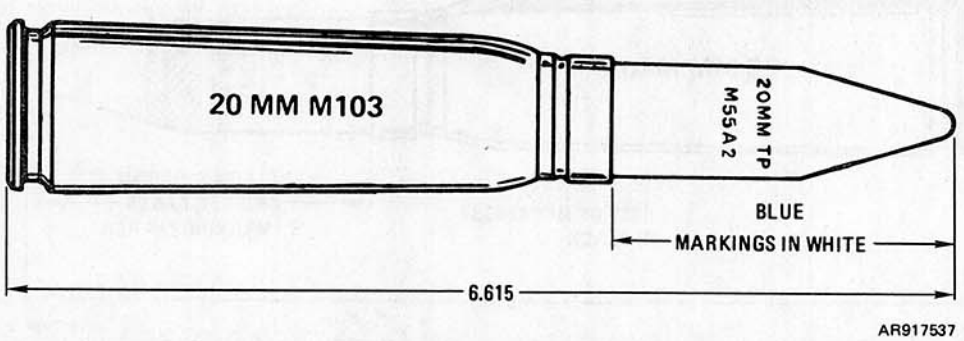


Figure 5-4. Marking of M55A2 20-mm Cartridge

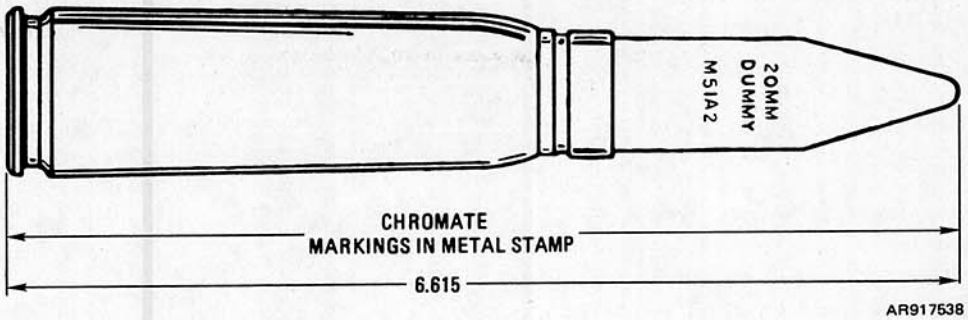


Figure 5-5. Marking of M51A1 20-mm Cartridge

Section II. PREPARATION FOR FIRING

Ammunition will be visually inspected to assure that it is clean, free of grease and corrosion, and that it is free of perforations, cracks and splits, severe scratches, cuts and dents other than those caused by normal delinking and relinking operations.

Section III. CARE, HANDLING AND PRESERVATION

Explosive ammunition must be handled with appropriate care at all times. Explosive elements such as primers and fuzes are sensitive to excessive shock, electrical discharge, and temperature. Keep ammunition in a serviceable condition and ready for immediate use as follows:

- Store ammunition in original containers in a dry, well-ventilated place protected from rays of sun and other sources of excessive heat.
- Keep ammunition and its container clean and dry and protected from possible damage.
- Disassembly of components of ammunition, such as fuzes and primers, is strictly prohibited. Any alteration of ammunition is hazardous and shall not be undertaken. Relinking of ammunition is permitted.
- Do not open sealed ammunition containers or remove protective or safety devices until just before use.
- Return ammunition, prepared for firing but not fired, to its original packing and mark it appropriately. Use such ammunition first in subsequent firings in order to keep stocks of opened packages at a minimum.

APPENDIX A

REFERENCES

AR 70-50	Designating and Naming Military Aircraft, Rockets, and Guided Missiles
AR 95-1	Army Aviation General Provisions and Flight Regulations
AR 95-13	Safety Procedures for Operations and Movement of Army Aircraft on the Ground
AR 95-16	Weight and Balance – Army Aircraft
AR 385-40	Accident Reporting and Records
FM 10-68	Aircraft Refueling
LO 9-1090-206-12	Armament Subsystem, Helicopter; 20-mm Automatic Gun: XM97E1
TB MED 251	Noise and Conservation of Hearing
TM 9-1005-257-12	Operator and Organizational Maintenance: Armament Pod, Aircraft 7.62-mm Machine Gun: M18 and M18A1
TM 9-1055-460-14	Operator, Organizational, Direct Support, General Support Maintenance: 2.75 Inch Aircraft Rocket Launcher M158A1, M200, and M200A1
TM 9-1090-206-12	Aviation Unit Maintenance Manual for Armament Subsystem, Helicopter; 20-mm Automatic Gun: XM97E1
TM 9-1090-206-20P	Aviation Unit Maintenance Repair Parts and Special Tools List for Armament Subsystem, Helicopter; 20-mm Automatic Gun: XM97E1
TM 9-1090-206-30	Aviation Intermediate Maintenance Manual for Armament Subsystem, Helicopter; 20-mm Automatic Gun: XM97E1
TM 9-1090-207-13&P	Aviation Unit and Intermediate Maintenance Manual With Repair Parts and Special Tools List (RPSTL) (Including Depot Maintenance Repair Parts and Special Tools) for Stores Management
TM 9-1270-212-14&P	Operator, Organizational, Direct and General Support Maintenance Manual for XM128 and XM136 Helmet Sight Subsystem (HSS) (Including Depot Maintenance Repair Parts and Special Tools List)
TM 9-1300-206	Care, Handling, Preservation and Destruction of Ammunition
TM 9-1425-473-20	Organizational Maintenance Instructions Armament Subsystem, Helicopter, TOW Guided Missile M65
TM 9-1425-473-34	Direct and General Support Maintenance Instructions Armament Subsystem, Helicopter, TOW Guided Missile M65
TM 9-4933-211-14	Operator, Organizational, Direct Support, and General Support Maintenance Manual for Portable Hydraulic/Electric Power Supply
TM 9-4933-211-34P	Direct Support and General Support Maintenance Repair Parts and Special Tools Lists (Including Depot Maintenance Repair Parts and Special Tools) for Portable Hydraulic/Electric Power Supply
TM 9-4933-224-13&P	Aviation Unit and Intermediate Maintenance Manual With Repair Parts and Special Tools List (RPSTL) (Including Depot Maintenance Repair Parts and Special Tools) for Electronic System Test Set XM137
TM 38-750	The Army Maintenance Management System (TAMMS)
TM 55-1520-236-10	Operators Instructions – AH-1S Helicopter
TM 55-1520-236-CL	Operators and Crewmembers Checklist – AH-1S Helicopter
TM 55-1520-236-23	Aviation Unit and Intermediate Maintenance Instructions, AH-1S Helicopter

TM 55-1520-239-10	Operators Instructions – AH-1G/S (MC) Helicopter
TM 55-1520-239-CL	Operators and Crewmembers Checklist – AH-1G/S (MC) Helicopter
TM 55-1520-239-23	Aviation Unit and Intermediate Maintenance Instructions, AH-1G/S (MC) Helicopter

APPENDIX B

MAINTENANCE ALLOCATION CHART

Section I. INTRODUCTION

B-1 General.

a. This section provides an explanation of all maintenance and repair functions authorized at various maintenance levels.

b. The Maintenance Allocation Chart (MAC) in Section II designates overall responsibility for the performance of maintenance functions on the identified end item or component. The implementation of the maintenance functions upon the end item or component will be consistent with the assigned maintenance functions.

c. Section III lists the special tools and test equipment required for each maintenance function as referenced from Section II.

d. Section IV contains supplemental instructions and explanatory notes for a particular maintenance function.

B-2. Maintenance Functions.

a. *Inspect.* To determine serviceability of an item by comparing its physical, mechanical and electrical characteristics with established standards.

b. *Test.* To verify serviceability by measuring the mechanical or electrical characteristics of an item and comparing those characteristics with prescribed standards.

c. *Service.* To clean, to preserve, to charge, and to add fuel, lubricants, cooling agents and air.

d. *Adjust.* To maintain mechanical or electrical characteristics to their proper operating range.

e. *Align.* To adjust specified variable elements of an item to bring to optimum performance.

f. *Calibrate.* To determine the corrections to be made in the readings of instruments or test equipment used in precise measurement. Consists of the comparison of two instruments, one of which is a certified standard of known accuracy, to detect and adjust any discrepancy in the accuracy of the instrument or test equipment being compared with the certified standard.

g. *Install.* To set up for use in an operational environment allowing proper functioning of an equipment or system.

h. *Replace.* To replace unserviceable items with serviceable assemblies, subassemblies or parts.

i. *Repair.* To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This includes, but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and strengthening.

j. *Overhaul.* To restore an item to a completely serviceable condition as prescribed by maintenance serviceability standards prepared and published for the specific item to be overhauled.

k. *Rebuild.* To restore an item to a standard as nearly as possible to the original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements (items) using original manufacturing tolerances and specifications, and subsequent reassembly of the item.

B-3. Explanation of Columns in the MAC, Section II.

a. *Column 1, Group Number.* Column 1 lists group numbers, the purpose of which is to identify components, assemblies, subassemblies, and modules with the next higher assembly.

b. *Column 2, Component Assembly.* Column 2 contains the names of components, assemblies, subassemblies, and modules for which maintenance is authorized.

c. *Column 3, Maintenance Functions.* Column 3 lists the functions to be performed on the item listed in column 2 (for detailed explanation of these functions, see para B-2).

d. *Column 4, Maintenance Level.* Column 4 specifies, by the listing of a "work time" figure in the appropriate subcolumn(s), the lowest level of maintenance authorized to perform the function listed in column 3. This figure represents the active time required to perform the maintenance function at the indicated level of maintenance. If the number or complexity of the tasks within the listed maintenance function vary at different maintenance levels, appropriate "work time" figures will be shown for each level. The number of manhours specified by the "work time" figure represents the average time required to restore an item (assembly, subassembly, component module, end item, or system) to a serviceable condition under typical field operating conditions. This time includes preparation time, troubleshooting time, and quality assurance/quality control time in addition to the time required to perform

the specific tasks identified for the maintenance functions authorized in the maintenance allocation chart. The symbol designations for the various maintenance levels are as follows.

O – Aviation Unit Maintenance
F – Aviation Intermediate Maintenance
D – Depot Maintenance

e. *Column 5, Tools and Equipment.* Column 5 specifies, by code, those common tool sets (not individual tools) and special tools, TMDE, and support equipment required to perform the designated function.

f. *Column 6, Remarks.* This column will, when applicable, contain a letter code in alphabetical order which will be keyed to the remarks contained in Section IV.

B-4. Explanation of Columns in Tool and Test Equipment Requirements Section III.

a. *Column 1, Reference Code.* The Tool and TMDE reference code correlates with a code used in the MAC Section II, Column 5.

b. *Column 2, Maintenance Level.* The lowest level of maintenance authorized to use the tool or test equipment.

c. *Column 3, Nomenclature.* Name or identification of the tool or test equipment.

d. *Column 4, National Stock Number.* The National Stock number of the tool or TMDE.

e. *Column 5, Tool Part Number.* The manufacturer's part number.

B-5. Explanation of Columns in Remarks Section IV.

a. *Reference Code.* The code recorded in column 6, Section II.

b. *Remarks.* This column lists information pertinent to the maintenance function being performed as indicated in the MAC, Section II.

Section II. MAINTENANCE ALLOCATION CHART

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
00	20-mm Automatic Gun: Helicopter Armament Subsystem; XM97E1	Inspect	0.2	0.7		1,5,6	A
		Test	0.2			5	A
		Service	0.3			6	
		Align	0.3	4.0		1,5,6	AB
		Replace		8.0		5,6,7,8	A
		Repair	1.0	2.0		2 thru 16	
		Overhaul			323	1 thru 16	
01	Declutching Feeder Assembly M89E1	Inspect	0.1			4	
		Service	0.1				
		Install	0.1			6	
		Replace	0.1			6	
		Repair	1.0	1.2		4,6,7	
		Overhaul			8.0	4,6,7	
02	20-mm Gun Automatic M197	Inspect	0.1			15	
		Service	1.5			6	
		Install	0.2			6	
		Replace	0.2			6	
		Repair	0.3	1.5		6,8,15	
		Overhaul			16.0	6,8,15	
0201	Mid-Barrel Clamp	Inspect	0.1				
		Install	0.1			6	
		Replace	0.1			6	
		Repair	0.2			6	
0202	Breech Bolt Assembly	Inspect	0.1			6,8	
		Service	0.2			6	
		Install	0.2			6	
		Replace	0.2			6	
		Repair	0.2			6,8	
0203	Firing Contact Assembly	Inspect	0.1			8	
		Install	0.2			6	
		Replace	0.2			6	
		Repair	0.1	0.2		6	
0204	Rotor Matched Housing	Inspect	0.1	0.2		6	
		Service	0.1				
		Install	0.1			6	
		Replace	0.2			6	
		Repair		0.2		6	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
0205	Rotor Assembly	Inspect	0.1				
		Service	0.2				
		Install		0.2	6		
		Replace		0.3	6		
		Repair		0.2	6		
03	Helicopter Armament Subsystem Turret	Inspect	0.1	0.3		1,5,6	A
		Test	0.2			5	A,C
		Service	0.1			6	
		Repair	0.7	1.0		5 thru 9	A
0301	Gun Drive Assembly	Inspect	0.1	0.2			
		Test	0.1			5	C
		Service	0.1				
		Install	0.3			6	
		Replace	0.3			6	
		Repair		0.5		6,7	
		Overhaul			4.0	6,7,8	
0302	Recoil Adapter Assembly	Inspect	0.1	0.2		6	
		Service	0.1				
		Adjust		0.5		6,2	
		Install	0.2			6	
		Replace	0.2			6	
		Repair		0.3		6	
		Overhaul			4.0	2,6	
0303	Slider Assembly	Inspect	0.1				
		Service	0.1				
		Install	0.1			6	
		Replace	0.1			6	
		Repair		0.3		6	
0304	Turret Assembly	Inspect	0.2			6	A
		Test	0.1			5	C
		Adjust	0.5	0.7		6,7	
		Install		4.0		6,7	
		Repair	4.0	4.5		6,7	
030401	Azimuth Resolver Assembly	Inspect	0.1	0.3		6	
		Test	0.2			5,6	C,A
		Adjust		0.5		6	
		Replace		1.5		6	
		Repair		0.7		6,7	
		Overhaul			4.0	6,7	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
030402	Azimuth Drive Assembly	Inspect	0.1	0.1			
		Test	0.1	1.8		5	C,A
		Adjust		0.4		6,3	
		Install		1.0		6	
		Replace		1.0		6	
		Repair		1.5		3,6	
		Overhaul			4.0	3,6,7	
030403	Gun Saddle Assembly	Inspect	0.1	0.5		6	
		Service	0.1				
		Repair		0.5		6,7	
		Overhaul			8.0	6,7	
030404	Lower Support Assembly	Inspect	0.1			6	
		Service	0.1			6	
		Repair	0.3	0.5		6,7	
		Overhaul			4.0		
03040401	Emergency Stow Control	Inspect	0.1	0.2			
		Test	0.1	0.2		5	A
		Install	0.5			6	
		Replace	0.5			6	
		Repair		0.5		6,7	
		Overhaul			16.0		
0304040101	Component Assy, A1	Inspect		0.2		6	
		Test	0.1			5	A,C
		Install		0.5		6,7	
		Replace		0.5		6,7	
		Repair			1.0	6,7,8	
0304040102	Components Assy, A2	Inspect		0.2		6	
		Test	0.1			5	A,C
		Install			0.5	6,7	
		Replace			0.5	6,7,8	
0304040103	Component Assy, A3	Inspect		0.2		6	
		Test	0.1			5	A,C
		Install		0.5		6	
		Replace		0.5		6	
		Repair			1.0	6,7,8	
03040402	Support Assy, Matched	Inspect	0.1	0.2			
		Service	0.1				
		Install		3.0		6	
		Repair		1.0		6,7	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
030405	Special Branched Cable Assembly	Inspect	0.1		2.0	8	
		Replace	0.3		24.0	6	
030406	Special Branched Cable Assembly	Inspect	0.1		2.0	8	
		Replace	1.3		24.0	6	
030407	Special Branched Cable Assembly	Inspect	0.1		2.0	8	
		Replace	1.3		24.0	6	
030408	Special Branched Cable Assembly	Inspect	0.1		2.0	8	
		Replace	1.3		24.0	6	
030409	Upper Matched Support Assembly	Inspect		0.1			
		Service		0.1		6,7	
		Repair		0.5		6,7	
		Overhaul			4.0	6,7	
0305	Ammunition Feed System	Inspect	0.1			6	
		Service	0.1			6	
		Install	0.6			6	
		Replace	0.6			6	
		Repair	0.1	0.5		6	
		Overhaul			16.0	6	
030501	Feed Chute Assembly	Inspect	0.1			6	
		Repair	0.2			6	
030502	Ammunition Box Assembly	Inspect	0.1			6	
		Install	0.3			6	
		Replace	0.3			6	
		Repair		0.5		6	
		Overhaul			8.0	6	
030503	Cover Assembly	Inspect	0.1			6	
		Replace	0.1			6	
		Repair		0.5		6	
03050301	Booster Assembly	Inspect	0.1				
		Test	0.1			5	A,C
		Service	0.1				
		Install	0.3			6	
		Repair	0.2			6	
		Overhaul			4.0	6	
030504	Box Assembly	Inspect	0.1			6	
		Repair		0.5		6	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
0306	Gun Control Assembly	Inspect	0.1	0.2		6	
		Test	0.2			5	A
		Install	0.3			6	
		Replace	0.3			6	
		Repair		0.5		6,8	
		Overhaul			16.0	6,8	
030601 to 030605	Circuit Card Assys A1 thru A5	Inspect		0.2		6	
		Test	0.1			5	A,C
		Install		0.1		6	
		Replace		0.1		6	
		Repair			3.0	6,7,8	
0307	Turret Control Assembly	Inspect	0.1	0.2		6	
		Test		0.2		5	A
		Adjust		0.3		6	
		Install	0.3			6	
		Replace	0.3			6	
		Repair		0.5		6,8	
		Overhaul			16.0	6,8,9	
030701 to 030703	Circuit Card Assys A1 thru A4	Inspect		0.2		6	
		Test	0.1			5	A,C
		Adjust		0.2		5,6	A,C
		Install		0.1		6	
		Replace		0.1		6	
		Repair			3.0	6,7,8	
030704	Electronic Components Assy	Inspect		0.2		6	
		Test		0.1		5	A,C
		Install		0.5		6	
		Replace		0.5		6	
		Repair			1.0	5,6	
030704	Electronic Component Assy	Inspect			0.1	6,8	
		Install			0.2	6	
		Replace			0.2	6	
		Repair			0.2	6	
030706	Printed Wiring Board A5	Inspect		0.2		6	
		Install		0.5		6	
		Replace		0.5		6	
		Repair			1.0	5,6	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
030707	Component Assy	Inspect		0.2		6	
		Test					
		Install			0.5	6	
		Replace			0.5	6	
		Repair			1.0	5,6,7	
0308	Logic Control Unit	Inspect	0.1	0.2		6	
		Test		0.2		5	
		Install	0.3			6	
		Replace	0.3			6	
		Repair		0.5		6,7,8	
		Overhaul			16.0	6,7,8	
030801 thru 030805	Circuit Card Assys, A1, A2, A4 thru A7 (no A3 designator)	Inspect		0.2		6	
		Test		0.1		5	A,C
		Install		0.3		6	
		Replace		0.3		6	
		Repair			3.0	5,6,7	
04	Gunner Control Panel	Inspect	0.1				
		Test	0.5			5	
		Install	0.1			6	
		Replace	0.1			6	
		Repair	0.1	0.2		6,7,8	
		Overhaul			7.0	6,7,8,5	A
05	Pilot Control Panel	Inspect	0.1			5,8,9	
		Test	0.5				
		Install	0.1			6	
		Replace	0.1			6	
		Repair	0.1	0.2		6,7,8	
		Overhaul			8.0	6,7,8,5	A
06	Interface Control Unit	Inspect	0.1	0.2		6	
		Test	0.2			5	A
		Adjust		0.5		6	
		Install	0.2			6	
		Replace	0.2			6	
		Repair		0.5		6,7,8	
		Overhaul			16.0	5,6,7,8	A
0601 to 0603, & 0607 to 0614	Circuit Card Assemblies, A1,A2,A3 for XM97E1 & A1-A5, A8,A9, for XM97E2	Inspect		0.2		6	
		Test		0.1		5	A,C
		Install		0.5		6	
		Replace		0.5		6	
		Repair			3.0	5,6,7	

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
0604	Resolver Mount Assy	Inspect		0.2		6	
		Test		0.1		5	
		Adjust		0.5		6	
		Install		2.0		6	
		Replace		2.0		6	
		Repair		1.0		5,6,7	
07	Reflex Sight	Inspect	0.2				
		Service	0.1			10,11,12,13	
		Adjust	0.8	1.0			
		Align		0.5			
		Install	0.5			6	
		Replace	0.5			6,8	
		Repair	0.2	0.5		6,7,8	
		Overhaul			12.0		
0708	Pilot Sight Support	Inspect	0.1				
		Service	0.1				
		Install		0.3		6,8	
		Replace			0.5	6,8	
		Repair	0.2	0.3	1.0	6,7,8	
08 M	Logic Relay Assy	Inspect	0.1			6	
		Test	0.2			5, 17	A
		Install	0.2			6	
		Replace	0.2			6	
		Repair		8.0		6,7,8	
0801 to 0803	Circuit Board Assys, A1, A2, A3	Inspect		0.1		6	
		Install		0.5		6	
		Replace		0.5		6	
		Repair			2.0	6,7,8	
09	Acquisition, Switch, Panel and Connector	Inspect	0.2				
		Test	0.3			5, 8	D
		Repair		0.2		6, 7, 8	
		Install	0.2			6	
		Replace	0.2			6	
10 M	Turret Buffer Amplifier Assy	Inspect	0.2				
		Test	0.2			5, 17	A
		Repair		0.5		6,7,8	A
		Install	0.2			6	
		Replace	0.2			6	
		Overhaul			2.0	5,6,7,9	A

MAINTENANCE ALLOCATION CHART – Continued

(1) Group Number	(2) Component/Assembly	(3) Maint. Function	(4) Maint. Category AVUM	AVIM	DEPOT	(5) Tool/ Equipment	(6) Remarks
1001	Circuit Card Assy A1	Inspect		0.2			
		Test		0.3		6,7,8	
		Install		0.2		6,7	
		Replace		0.2		6,7	
		Repair		0.3	1.0	5,6,7,9	
	Maintenance Allocations Miscellaneous Items						
9301	Universal Boresight Kit	Inspect	0.1				
		Replace	0.1				
		Repair			8.0	6	
9305	Barrel Erosion Gage, Kit	Inspect	0.1				
		Replace	0.1				
		Repair	0.2				
9306	Power Supply, 28 VDC, 115 VAC-400 Hz.	Inspect		0.2			
		Test		0.2		8	
		Adjust		0.3		6,8	
		Repair		0.5		6	
		Replace		0.1			
		Overhaul		8.0		6,8	

Section III. TOOL AND TEST EQUIPMENT REQUIREMENTS

(1) Reference Code	(2) Maintenance Level	(3) Nomenclature	(4) National Stock No.	(5) Tool Part No.
1	0,F,D	Boresight Kit		7249506
2	F,D	Gage, Preload; Recoil Adapter	5210-00-470-5267	101D4561
3	F,D	Fixture, Holding, Clutch Adjusting	1005-00-139-6178	101D4844
4	0,F,D	Fixture Testing Feeder	1005-00-433-2838	11838602
5	0,F,D	Test Set, Electronic System, XM137 Maintenance (AVUM/AVIM)	4933-01-063-7678	11830700
6	0,F,D	Tool Set, Basic Aircraft Armament Repairman	4933-00-987-9816	
7	F,D	Tool Set, Aircraft Armament Repairman Supplemental	4933-00-994-9242	
8	0,F,D	Multimeter AN/USM-223	6625-00-999-7485	
9	D	Multimeter, ME-26/U	6625-00-913-9781	
10	0,F,D	Adapter, Nitrogen Filling	4931-00-508-5453	
11	0,F,D	Hose Assembly, Rubber	4720-00-561-0713	
12	0,F,D	Regulator, Nitrogen Filling Pressure	4931-00-558-0922	
13	0,F,D	Nitrogen Technical Tank	6830-00-264-9086	
14	F,D	Portable Hydraulic/Electric Power Supply, Model HEPC-1	4933-00-933-4742	5910821
15	F,D	Gage, Barrel Erosion, M10		7249302
16	F,D	Power Supply	4933-01-086-8735	11834203
17	F, D	Oscilloscope AN/USM-228-2201	6525-00-228-2201	

Section IV. REMARKS

Reference Code	Remarks
A	Power equipment (Section III, items 14 and 16) is required for use of the XM137 test set at the AVIM and depot maintenance levels.
B	Alignment time is approximate as boresighting interfaces with other equipment (reference composite boresight procedures in Chapter 6).
C	Component or assy is tested during system functional test or next higher assy.
D	Although this item is not maintenance significant it is functionally required.

APPENDIX C

BASIC ISSUE ITEMS AND ITEMS TROOP INSTALLED OR AUTHORIZED LIST

Not Applicable

APPENDIX D

EXPENDABLE SUPPLIES AND MATERIALS LIST

Section I. INTRODUCTION

D-1. Scope. This appendix lists expendable supplies and materials you will need to operate and maintain the 20-mm Automatic Gun Helicopter Armament Subsystem XM97E1. These items are authorized to you by CTA 50-970, Expendable items.

D-2. Explanation of Columns.

a. *Column 1, Item number.* This number is assigned to the entry in the listing and is referenced in the narrative instructions to identify the material (e.g., "Use Epoxy coating, item 1, App D".)

b. *Column 2, Level.* This column identifies the lowest level of maintenance that requires the listed item.

O – Aviation Unit Maintenance

F – Aviation Intermediate Maintenance

c. *Column 3, National Stock Number.* This is the National stock number assigned to the item; use it to request or requisition the item.

d. *Column 4, Description.* Indicates the Federal item name and, if required, a description to identify the item. The last line for each item indicates the part number followed by the Federal Supply Code for Manufacturer (FSCM) in parentheses, if applicable.

e. *Column 5, Unit of Measure (U/M).* Indicates the measure used in performing the actual maintenance function. This measure is expressed by a two-character alphabetical abbreviation (e.g., ea. in. pr). If the unit of measure differs from the unit of issue, requisition the lowest unit of issue that will satisfy your requirements.

Section II. EXPENDABLE SUPPLIES AND MATERIALS

(1) Number	(2) Level	(3) National Stock Number	(4) Description	(5) U/M
1	0	8010-01-M106750	Coating, epoxy MIL-C-22750 (81349) Class 1, Type 3, clear	EA
2	0	9150-00-935-4017	Grease, aircraft MIL-G-23827 (81349)	OZ
3	0	9150-00-949-0323	Oil, lubricating MIL-L-46150 (81349)	TU
4	0	9150-00-273-2389	Oil, lubricating VV-L-800 (81348)	CN
5	0	6850-00-224-6663	Solvent, cleaning compound MIL-C-372 (81349)	CN
6	0	6850-00-264-9038	Solvent, mineral spirits P-D-680, Type II (81348)	CN
7	0	9505-00-221-2650	Wire, nonelectrical MS20995C20 (96906)	EA
8	0	9505-00-293-4208	Wire, nonelectrical MS20995C32 (96906)	EA
9	0		Oil, lubricating MIL-L-14107 (81349)	

GLOSSARY

Definitions. Terms, abbreviations, and acronyms used herein are defined as follows:

ACQ	Acquisition
AZ	Azimuth
BIT	Built-In Test
BITE	Built-In Test Equipment
CCW	Counterclockwise
CW	Clockwise
EL	Elevation
ESCU	Emergency Stow Control Unit
FOV	Field of View
FRL	Fuselage Reference Line
FRP	Fuselage Reference Plane
GCP	Gunner Control Panel
GCU	Gun Control Unit
HSS	Helmet Sight Subsystem
IFCU	Interface Control Unit
It	Resolver Error Signal Cos Az Cos El
Jt	Resolver Error Signal Sine Az Cos El
Kt	Resolver Error Signal Sine El
LCU	Logic Control Unit
LHG	Left Hand Grip
LOD	Linkage Orientation Device
LOS	Line of Sight
LRU	Line Replaceable Unit
PCP	Pilot Control Panel
PFS	Pilot Fixed Sight
SAS	Stabilization Augmentation System
SHC	Sight Hand Control
TCP	TOW Control Panel
TCU	Turret Control Unit
TOW	Tube-Launched, Optically-Guided, Wire-Controlled
TSU	Telescopic Sight Unit
UTS	Universal Turret System
UUT	Unit Under Test
Vs	Velocity Jump Correction Voltage

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THE METRIC SYSTEM AND EQUIVALENTS

LINEAR MEASURE

1 Centimeter = 10 Millimeters = 0.01 Meters = 0.3937 Inches
1 Meter = 100 Centimeters = 1000 Millimeters = 39.37 Inches
1 Kilometer = 1000 Meters = 0.621 Miles

WEIGHTS

1 Gram = 0.001 Kilograms = 1000 Milligrams = 0.035 Ounces
1 Kilogram = 1000 Grams = 2.2 Lb
1 Metric Ton = 1000 Kilograms = 1 Megagram = 1.1 Short Tons

LIQUID MEASURE

1 Milliliter = 0.001 Liters = 0.0338 Fluid Ounces
1 Liter = 1000 Milliliters = 33.82 Fluid Ounces

SQUARE MEASURE

1 Sq Centimeter = 100 Sq Millimeters = 0.155 Sq Inches
1 Sq Meter = 10,000 Sq Centimeters = 10.76 Sq Feet
1 Sq Kilometer = 1,000,000 Sq Meters = 0.386 Sq Miles

CUBIC MEASURE

1 Cu Centimeter = 1000 Cu Millimeters = 0.06 Cu Inches
1 Cu Meter = 1,000,000 Cu Centimeters = 35.31 Cu Feet

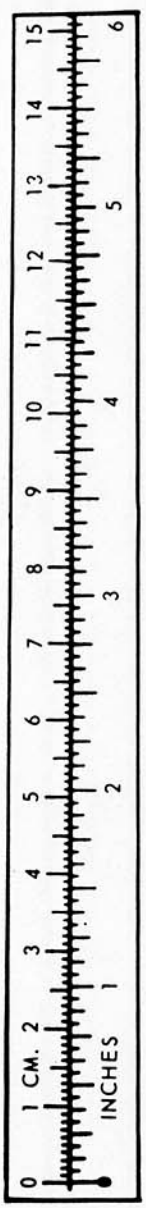
TEMPERATURE

$5/9\ (^0F - 32) = {}^0C$
212^0 Fahrenheit is equivalent to 100^0 Celsius
90^0 Fahrenheit is equivalent to 32.2^0 Celsius
32^0 Fahrenheit is equivalent to 0^0 Celsius
$9/5\ C^0 + 32 = F^0$

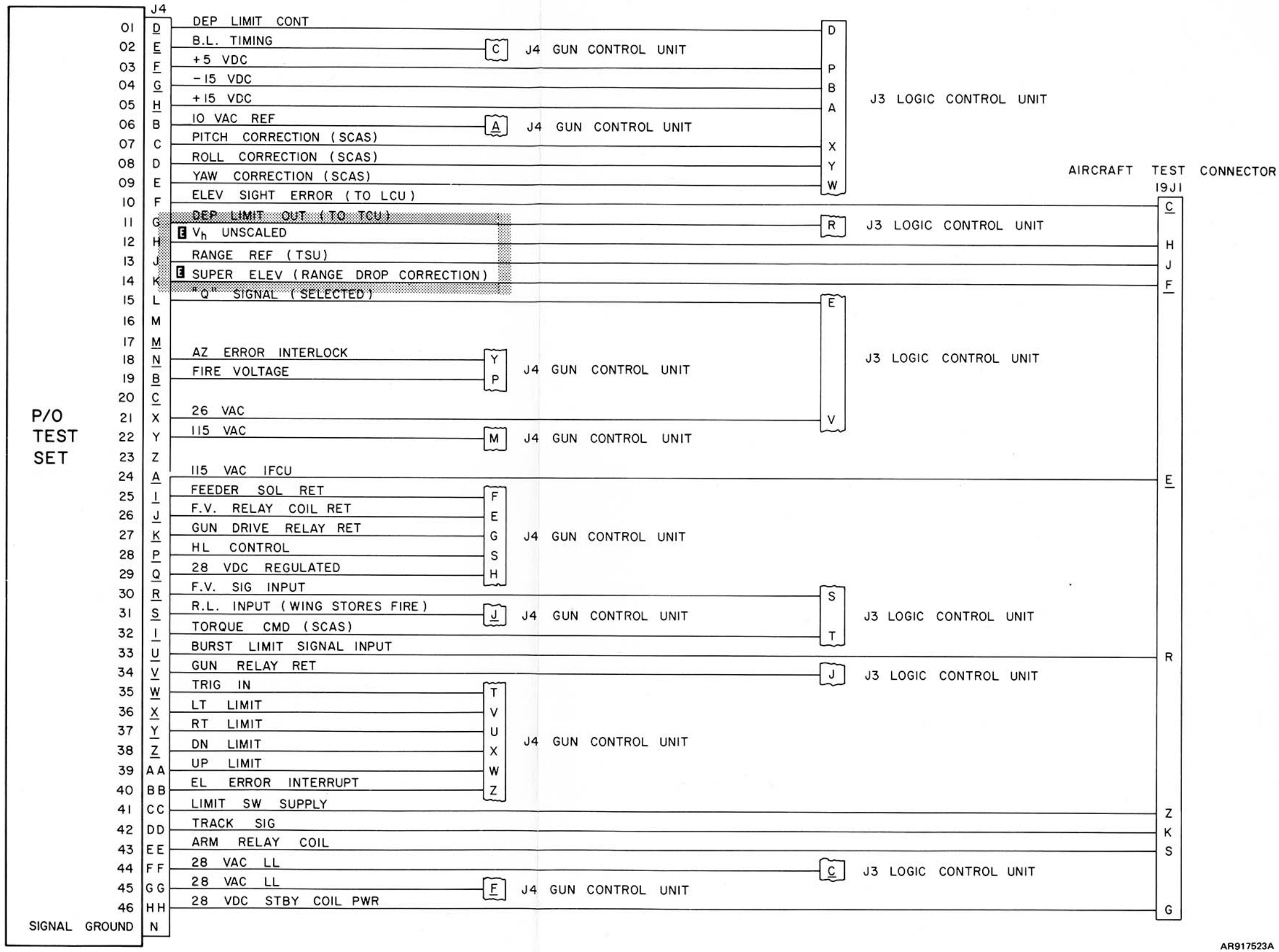
APPROXIMATE CONVERSION FACTORS

TO CHANGE	TO	MULTIPLY BY
Inches	Centimeters	2.540
Feet	Meters	0.305
Yards	Meters	0.914
Miles	Kilometers	1.609
Square Inches	Square Centimeters	6.451
Square Feet	Square Meters	0.093
Square Yards	Square Meters	0.836
Square Miles	Square Kilometers	2.590
Acres	Square Hectometers	0.405
Cubic Feet	Cubic Meters	0.028
Cubic Yards	Cubic Meters	0.765
Fluid Ounces	Milliliters	29.573
Pints	Liters	0.473
Quarts	Liters	0.946
Gallons	Liters	3.785
Ounces	Grams	28.349
Pounds	Kilograms	0.454
Short Tons	Metric Tons	0.907
Pound-Feet	Newton-Meters	1.356
Pounds per Square Inch	Kilopascals	6.895
Miles per Gallon	Kilometers per Liter	0.425
Miles per Hour	Kilometers per Hour	1.609

TO CHANGE	TO	MULTIPLY BY
Centimeters	Inches	0.394
Meters	Feet	3.280
Meters	Yards	1.094
Kilometers	Miles	0.621
Square Centimeters	Square Inches	0.155
Square Meters	Square Feet	10.764
Square Meters	Square Yards	1.196
Square Kilometers	Square Miles	0.386
Square Hectometers	Acres	2.471
Cubic Meters	Cubic Feet	35.315
Cubic Meters	Cubic Yards	1.308
Milliliters	Fluid Ounces	0.034
Liters	Pints	2.113
Liters	Quarts	1.057
Liters	Gallons	0.264
Grams	Ounces	0.035
Kilograms	Pounds	2.205
Metric Tons	Short Tons	1.102
Newton-Meters	Pound-Feet	0.738
Kilopascals	Pounds per Square Inch	0.145
Kilometers per Liter	Miles per Gallon	2.354
Kilometers per Hour	**Miles per Hour**	0.621

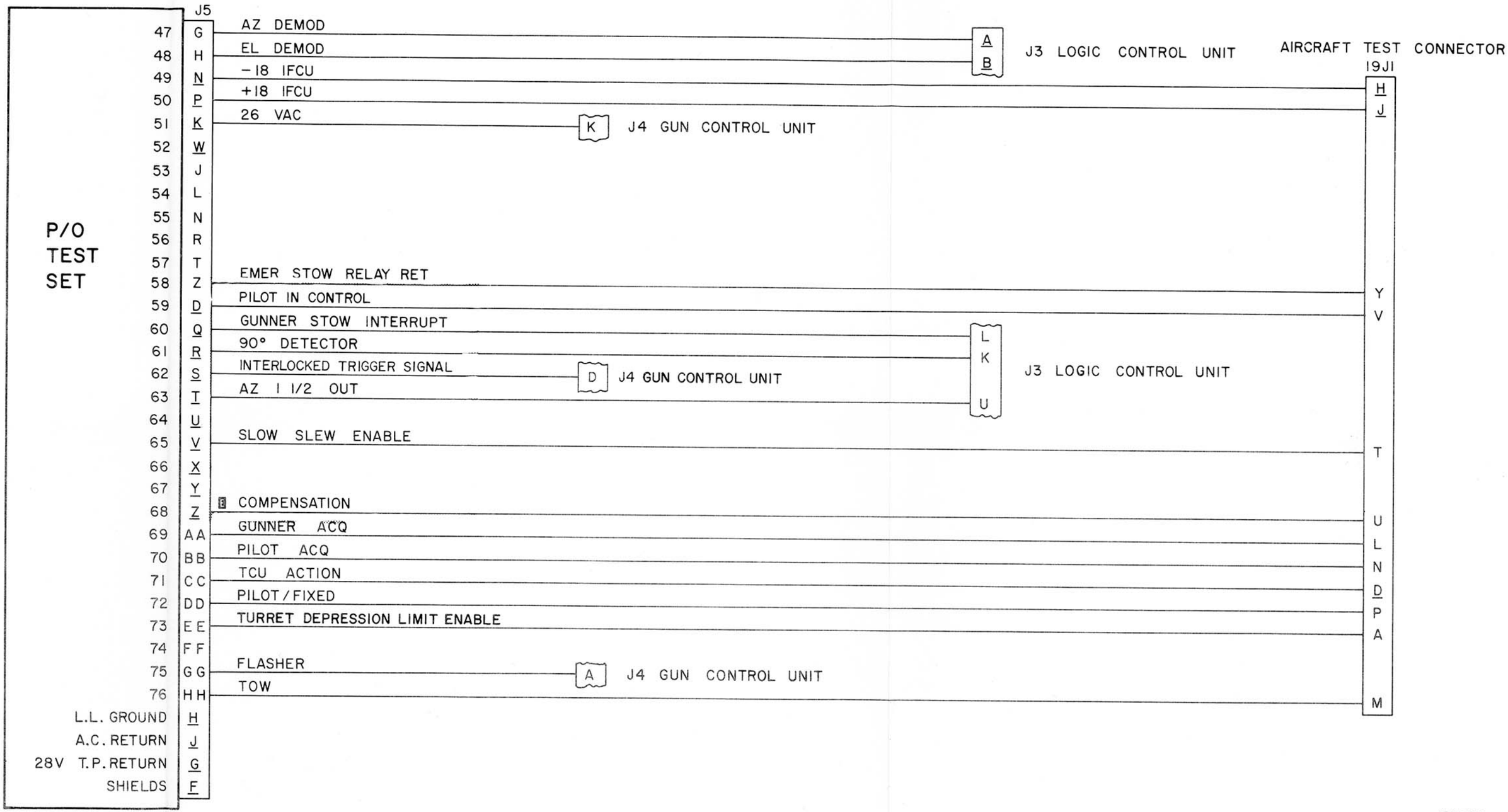


TA089991



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Figure FO-1. Test Set DVM Address Identifications (Sheet 1 of 2)



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Figure FO-1. Test Set DVM Address Identifications (Sheet 2 of 2)

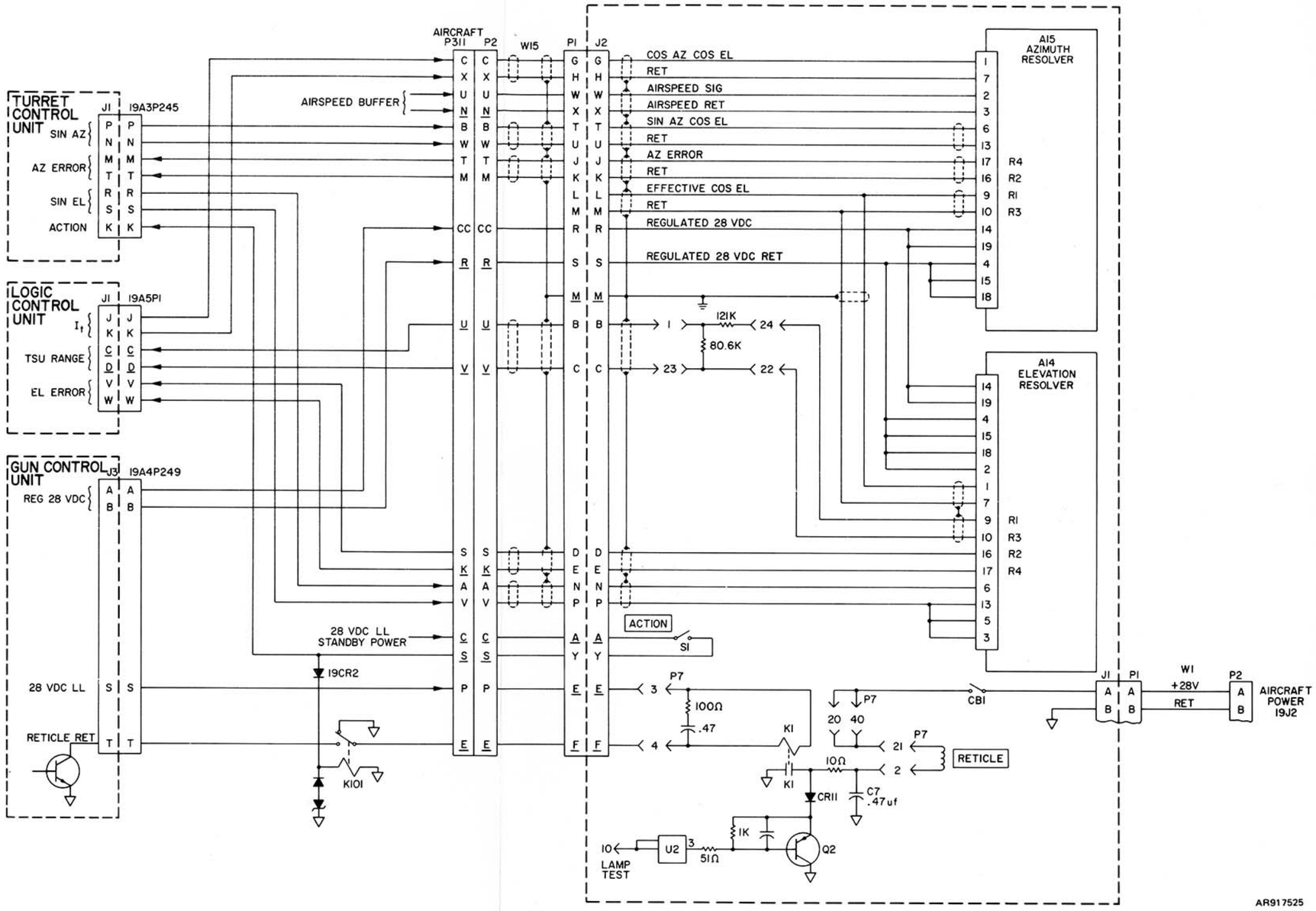
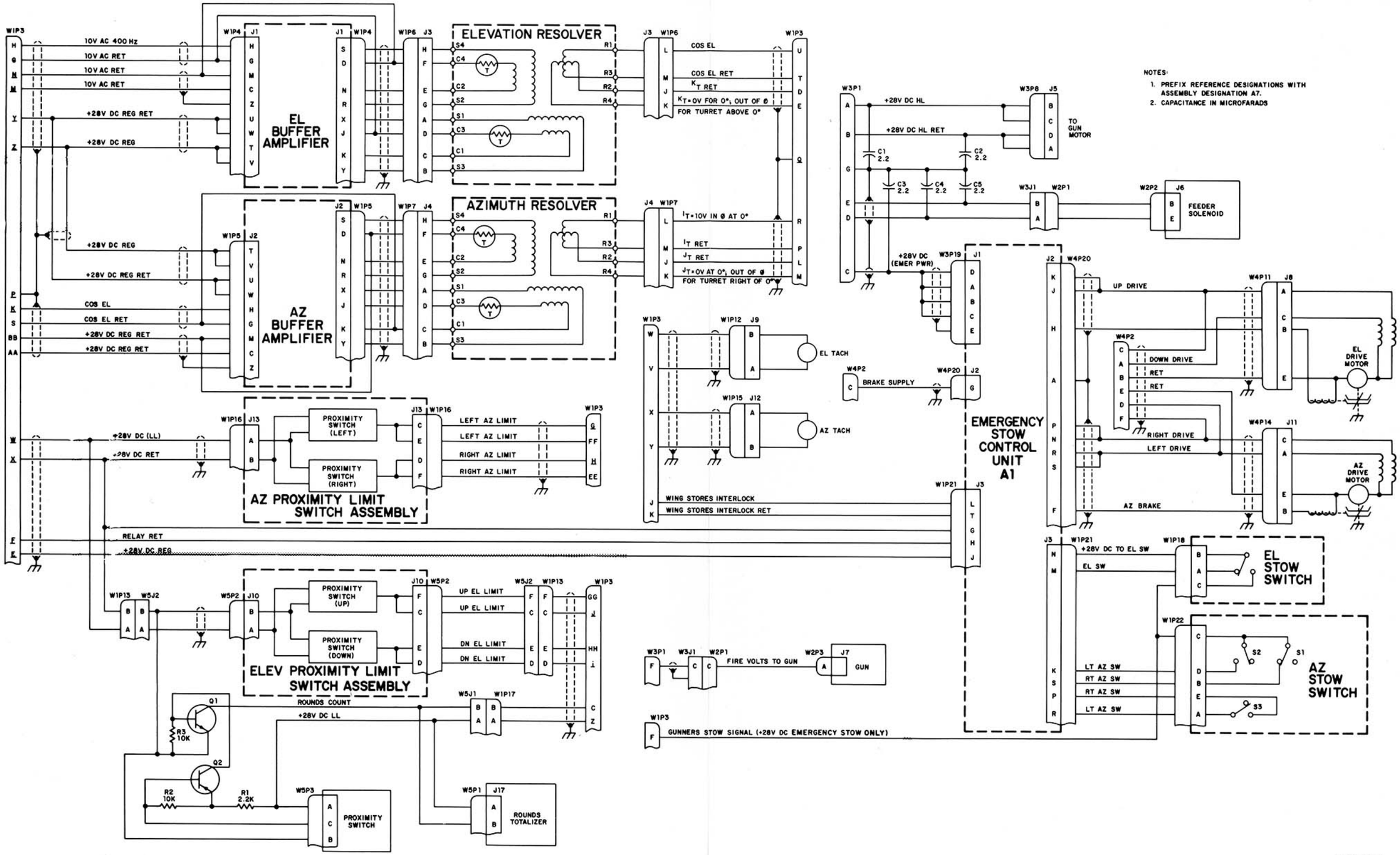


Figure FO-2. Test Set Sight Simulator Interface Diagram



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Figure FO-3. Turret Assembly Schematic Diagram

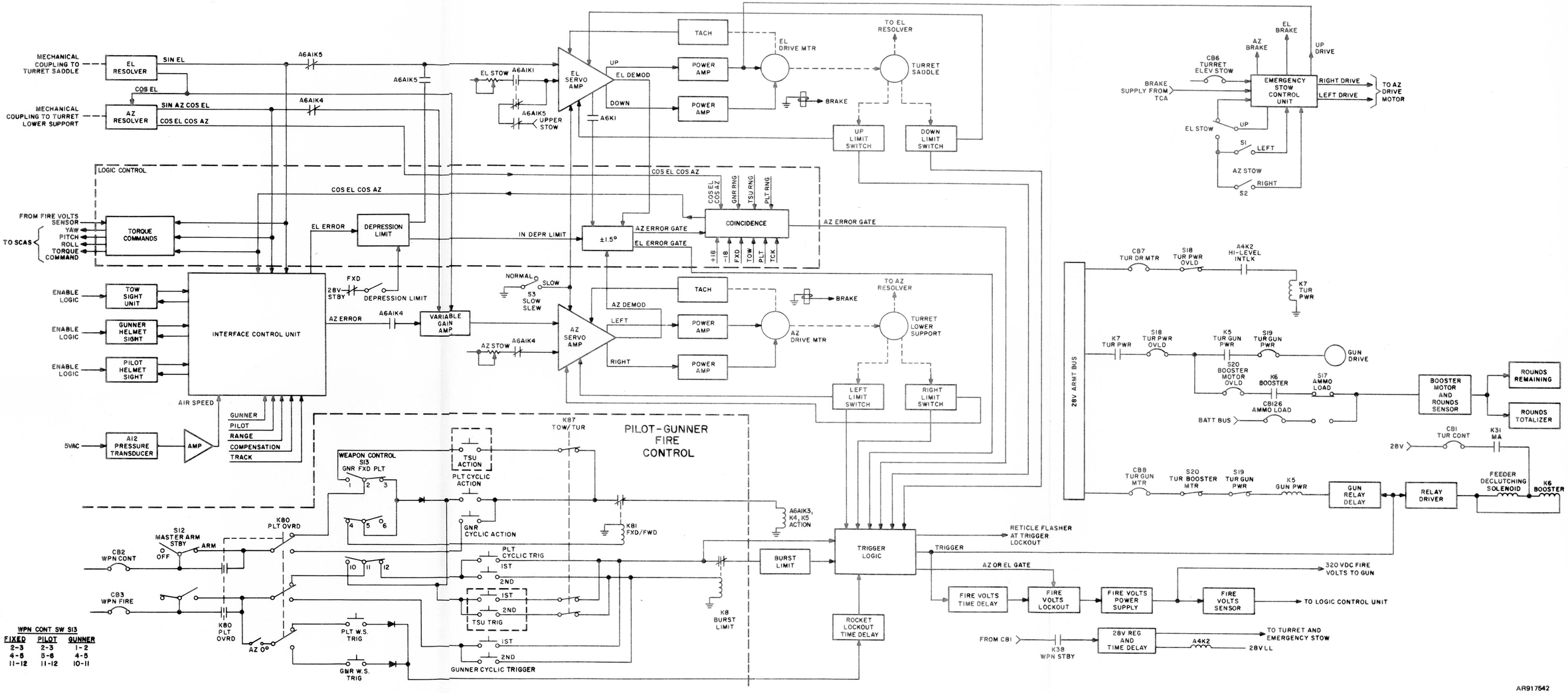
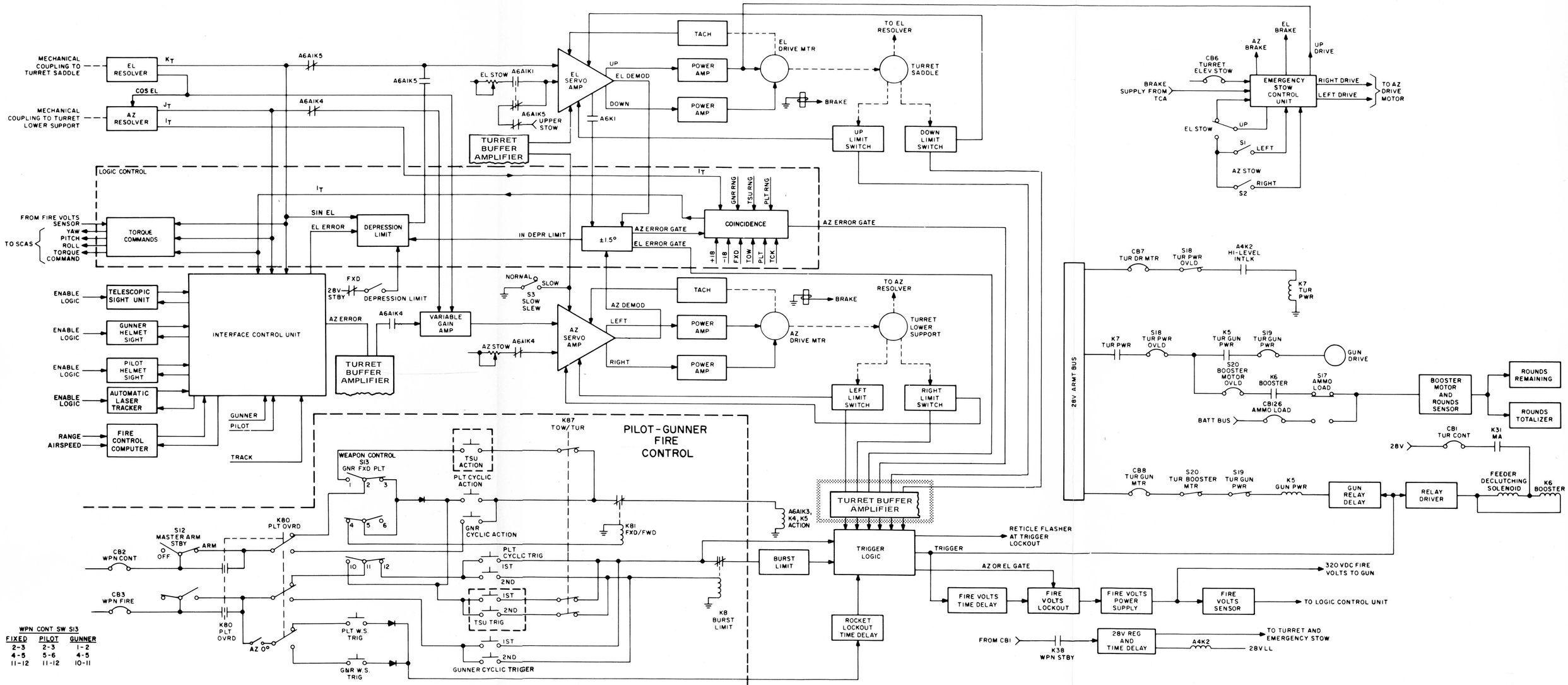


Figure FO-4. 20-mm Gun System Overall Block Diagram



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M *Figure FO-4.1 20-mm Gun System Overall Block Diagram*

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